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Instruction in Highway Engineering.

Highway engineering has come to mean but little else than location, construction and maintenance of roads and pavements, although as a matter of fact it ought to cover what may broadly be considered the economics of such roads and pavements; that is, the efficiency and economics of roads and pavements as means of transportation, just as railroad economics include corresponding elements of the general subject of transportation. This side or department of highway economics seldom receives any consideration, for the obvious reason that highways are public property, and they are not subject to the same considerations of profit and loss as are the properties of such private, or at most, semi-public corporations as the railroads of this country. If, however, the economics of transportation on highways are not pressing for consideration the economics of location, construction and maintenance certainly need far more attention than they have ever received. Railroads have been built far ahead of conditions necessary for the earning of dividends. While such results are disappointing to investors, the interests of the community as a whole have been, beyond any question, served by this pioneer railroad construction and extraordinary stimulation given to the development of many portions of the country. It is a little singular that improved highway construction has generally been regarded from an entirely different point of view.

Fortunately, a material change in the attitude of the public toward improved highways has taken place in some important quarters. The intense congestion in large cities has undoubtedly reacted already to a considerable extent in favor of the development of not only suburban but many country districts. Indeed, in most states of the Union the necessity for improved highways along main lines of country transportation is clearly realized, and state aid for the construction of such roads is no longer uncommon. The enhancement of value of country lands in towns and villages, and even in some more remote agricultural districts, is now seen to be largely dependent upon a greatly improved condition of highway transportation, over that which has hitherto existed. While statistics bearing upon the point are scarcely available, it is not at all improbable that the real property directly affected by the improvement of highways is far greater than that immediately served by railroads. Some idea of this feature of the subject can be obtained by reflecting upon a statement made by Mr. A. N. Johnson, highway engineer of the Department of Agriculture, in a paper recently read before the Society for the Promotion of Engineering Education, to the effect that there is now spent annually in this country "not less than $50,000,000 in maintaining public roads and bridges"; in fact, the sum is probably far greater.

This paper by Mr. Johnson was printed in The Engineering Record of July 8 and contains a plea for instruction in highway engineering well worthy of careful and favorable attention of the engineering schools of the country. He maintains the subject is of such importance that it should practically be put on an equal footing with railroad engineering, even in respect to the economics of transportation, if we understand him correctly. He shows from an examination of the courses of study offered by fifteen prominent engineering schools, the great disparity in the time given to railroad and highway engineering. While every reader may not agree with Mr. Johnson in every detail of his statement, it is probable that few, if any, will attempt to controvert his position as to the main facts. If the consideration of costs of transportation on improved highways be omitted for the reasons stated above there remain a number of other elements of the general subject which can only be treated adequately by engineers possessing training and experience, and Mr. Johnson's plea for such engineers is well grounded and convincing.

The location of an improved highway is fairly well fixed by the topography and development, present or future, of a given district, but the type of road, materials of construction and other features affecting the costs of construction and maintenance, are subjects justifying the most careful engineering treatment. Perhaps the most serious obstacle to the progress of improved road construction heretofore encountered has been mainly the cost, and this depends largely upon the material used.

In the early days of improved roads it was generally supposed that metalling must be heavy and that the materials for the surface should possess certain packing and cementing qualities possessed to the proper extent by but few kinds of stone found only in highly favored localities. As experience in this line of engineering work has extended, however, it has been found, as might be anticipated, that in practically every locality suitable materials at reasonable cost may be found convenient to the work. It has further been realized that the depth of metalling and width of roadway may and should be fixed to meet the demands of the traffic to be accommodated. Heavily metalled roads with comparatively costly surfacing are certainly needed for heavy traffic, but they are extravagant and entirely unnecessary for light country roads. These various elements of design suited to the requirements of actual traffic to be accommodated, that is, adapted to the needs of the district served, can only be prescribed by the engineer qualified by training and experience to solve the problems of highway engineering He has his special field in which the proper discharge of duties is based upon engineering considerations of the highest order. He must be familiar with the properties of available road materials of each road district and be able to make such manipulation and combination of them as will result in the best possible roadway for the traffic which it has to carry, and at a cost which will not throw too heavy a burden upon the community. While he does not treat quantitatively the economics of transportation over the roads which he builds, the costs of construction and maintenance which he must determine with great care amount to about the same thing. In other words, the engineer whose field includes highway engineering meets complicated problems which affect great interests lying at the foundation of much of the country's prosperity and Mr. Johnson is right in contending that the engineering schools should so administer their instruction work as to give to the public the best highway engineers.

The Design of Heads for Tanks Under Pressure.

In the manufacture of large flanged and dished heads it is the usual practice to first cut a circular plate enough larger than the desired finished diameter to give the metal necessary for the flange and lap, after allowing for the increase required by the dishing. This plate is then heated red hot and placed on a form or mold, into which it is squeezed by a hydraulic press or other means until it has the required dish shape. The dished head is then firmly held down in place by a large die and slowly revolved, while at the same time a wheel, pressed against and rolling over the outside of the head, spins up the flange against the corner of the die all the way around. Sometimes the wheel fails to spin the flange fully up, or else the finished outside diameter of the flanged head may be a little too large for the shell with which it is to be used, and in such cases it occasionally happens that the flange is brought up to the desired point or its outside diameter is lessened by holding a fulling tool against the inside of the knuckle of the flange and striking this tool with a heavy sledge.

Whether the fuller and sledge are used or not, there is usually some thinning down of the metal of the plate at the knuckle, just where the curvature is sharpest. If the fuller and sledge are used in the manner described the result is a well-defined groove, almost amounting in its effect to a continuous nick around the inside of the knuckle.

While the use of the fuller and sledge is indefensible, the temptation to resort to it to bring the head to shape or size, when the work has to be done in a hurry and when there is no time to send the head back to the mill, is hard for a contractor to resist.

A year or more ago a large steel cooker burst, completely demolishing the building in which it was located, killing a number of persons and injuring several more. This cooker was a cylinder, 24 ft. long by 8 ft. in diameter, and had flanged and dished heads. The thickness of the shell of the cylinder was ½ in. and the original nominal thickness of the plates from which the flanged and dished heads were made was ⅝ in. All joints were double riveted, and all the material and workmanship, except the heads, appeared to be first-class in every particular. In the operation of the cooker it was supposed to be subjected eight or ten times daily to alternations of partial vacuum and 70 lb. steam pressure. As there was no safety valve on the cooker, it might possibly have been subjected at times to the full boiler pressure of 115 lb.

The cooker failed without previously observed leak or warning. One head was blown out, the line of fracture being entirely confined to the knuckle of the flange. The cooker had only been in service about a year and was in excellent preservation, inside and out. An examination of the head which failed, as well as of that which remained intact, showed in each head a well-defined groove all the way around the inside of the knuckle. This groove, which was made either by the corner of the die in spinning up the flange, or, as was much more probable, by the use of the fuller and sledge, after the flange had been spun partly up, was about 1¼ in. in width and nearly ⅛ in. deep. To break a wire one first nicks it and then bends it back and forth. The groove in the knuckle of the flange served in this case as a nick, and the alternations of pressure and vacuum did the bending—and the rest.

As in line with the rupture of the cooker may be mentioned the behavior of a certain large copper still, though fortunately this has not so far caused disaster by its failure. The still was originally a vertical cylinder 16 ft. in diameter and 12 ft. high, with flanged and dished heads. Its workmanship and material were of the very best and the thickness of the copper was ample for the maximum legitimate strains for which it was built. The still was subjected in operation to alternations of vacuum and low pressure. When under pressure the whole structure would rise several inches clear of its concave foundation at the outer edge, resting at such times only on the center of the bottom head. When the pressure was changed to vacuum the still would settle down and its weight would be carried more near the edge than in the center of the foundation. This constant bending back and forth, which was largely concentrated at the knuckle, made it impossible to keep a tight joint between head and shell, besides which the copper head was beginning to crack at the knuckle. Unable to see any other way out of their difficulty, those in authority reduced the diameter from 16 ft. to 15 ft., with consequent loss of capacity and no very great reduction in the risk of fatal accidents.

The still and the cooker above described are, of course, somewhat extreme cases of the dangers of large flanged and dished heads, but it is such extreme cases that always serve to point out defects and to bring about reforms. So long as flanged and dished heads were of comparatively small size their use gave cause for no complaint and developed no weak points in them. The obvious lesson to be drawn from the cases cited is that the flanged and dished head is not well suited for use in large vessels subjected to repeated variations of pressure. The shape of the head, and its method of construction, are such that it will change its form under varying pressure, and each such change of form results in the bending of the head at the knuckle, just where it is weakest.

The only figure which does not tend to change its form under internal or external pressure is the sphere. Tanks with flat or conical bottoms are giving place to tanks with spherical bottoms, and spherical cookers are in successful use in paper mills and elsewhere. Had the cooker and still described been built with spherical heads there would have been no need to record the fatalities and loss caused by the failure of the one, nor to dread a similar calamity from the other.

Construction Plant and Methods.

This is the season of the year when civil engineers of a business turn of mind have an opportunity to gain knowledge of one branch of their work that cannot be learned except superficially by study. This is the handling of construction, with respect to both plant and methods. It is a peculiarity of our system of technical education that the graduates from engineering colleges are much better posted and lay more weight on the design than the execution of works. For this reason the cost of works is not so readily estimated by them as by British engineers of the same age, who gained their theoretical education either during or after service in the office of some practicing engineer. Perhaps The Engineering Record may unduly estimate the importance of the financial side of engineering, but it nevertheless holds the opinion that the young engineer who does not early acquire the habit of estimating the cost as well as the merits of the design of the works he sees is allowing himself to become warped in his professional development.

There are a good many classes of work that occur so frequently on all kinds of construction that every engineer should be able to estimate their cost readily; among them are excavation in earth and rock, the construction of various classes of masonry, simple timber and steel framing, the ordinary plumbing and heating work in buildings and the like. With this knowledge well established by actual observation, it is possible to obtain a grasp in a general way of the cost of completed works, a subject that surprisingly few engineers are posted on. They can, it is true, estimate in a laborious way, the expense of such work, but the careful compilation of costs that was formerly embodied in the private note-books of engineers seems to have gone out of fashion. Possibly one reason for this is to be found in the complication of modern contracting equipment and methods, and the unusual opportunities which are afforded at this season of the year for securing information on this subject are worth considering. Young graduates who have the opportunity to do so, might very well put in some weeks or months in visiting works under construction in their vicinity, a practice that is greatly encouraged in Germany, but never seems to have secured much of a foothold here. A careful study on the spot of the way in which different undertakings are being executed will go a long way in fixing in the mind of the graduate the importance of much that he has been studying and open his eyes to the great practical field of which he has little actual knowledge.

In these days the difference in methods of handling the same kinds of work is very great. Since the technically educated man entered the employ of the contractor the latter has developed his plant far beyond its modest limits of a decade ago. The utilization of machinery has been very rapid, and even the simplest tools have received a careful study to make them as useful as possible. The first cost of an equipment is no longer the sole criterion employed in selecting plant, and the fact that a given piece of apparatus was employed successfully on a previous piece of work does not ensure its adoption on succeeding undertakings. In fact one of the most significant features of large construction at the present time is the diversity in the methods of contractors in handling somewhat similar work where the equipment goes beyond the plow, scraper, shovel and light railway class. Hence it is to be hoped that in the technical papers which will be prepared on this year's construction full attention will be paid to the contractor's as well as the engineer's part in the work. It has reached such a state of development that it must be recognized in the practical work of an engineering office, and there is no reason for keeping it out of the pages of the publications of the engineering societies.

Keeping Depreciation Records.

An important factor in the solution of many problems in engineering finance is the value assigned to depreciation. In large work a difference of but two or three per cent in the fixed charges represents a sum of money by no means negligible in its effect upon the annual balance sheet. For example, an investment in heavy engine-driven generating units totals $100,000. If we allow 8 per cent. depreciation, there must be $250 per month increased earnings to offset the difference between the former figure and a 5 per cent allowance which, in the case of an electric railway, means that 60,000 more passengers per year must be carried to come out even. Unfortunately, there is a great scarcity of reliable data upon the subject of depreciation, and every engineer whose work lies in the field of estimates knows how difficult it is even to approximate the proper percentages in dealing with various classes of machinery. Long experience gradually establishes probable limits of depreciation in familiar types of equipment, but the uncertainty which always surrounds such estimates is vastly increased in dealing with the newer productions of the factory.

Although accurate figures predicting the depreciation factor of a new machine are almost unattainable until that machine has demonstrated its ability to stand up under repeated repairs, a great deal can be done in the way of determining the life of standard equipment. It should generally be much easier to establish depreciation data than to preserve accurate maintenance figures. There is often much confusion of mind in defining depreciation, for in many accounting systems the items of maintenance include renewals. Depreciation is a property of equipment which repairs cannot remedy, and it has a close physical parallel in the gradual ageing of the human body, which, in a normal life finally passes the point where medical skill can maintain its functions. With every machine there finally comes a time when either repairs are of no avail in preserving the original usefulness of the equipment or through advances in applied science the device becomes out-of-date and consequently unequal to the demands of the times. From the date upon which the machine is placed in service a gradual falling off in value occurs, which may practically be expressed by the percentage obtained by dividing the useful life into 100. Second-hand equipment often rebates the original owner, but the peculiar conditions of each installation must be well weighed before it is safe to allow more than a small percentage of the original cost as a probable offset to the expense of replacing the equipment.

It is certainly desirable that better records of the life of engineering appliances and machinery should be preserved by those in a position to know the service conditions under which operation takes place. In order to accomplish this, there must be preserved, in card index or other flexible form, records of all the important equipment in an installation. The question can be elaborated as far as opportunity permits, but aside from the cost of repairs, which is of no small importance as an object of investigation, there must be a record of the useful life of each separate machine with a statement of its first cost, final selling or disposal price, if such there be, and the dates of beginning and ending service. By beginning such a method of analysis as this with reference to only a few large machines, an operating company opens the door toward further valuable investigation. It is far more important to know the probable life of an induction motor as a single machine than it is to know the life of its component parts, but as the first depreciation data broaden into detailed knowledge of many different types of equipment, room will be found for increased refinement of investigation. And finally, it is of cardinal importance to preserve such data in one place and to incorporate with it the main facts expressing the service in which the equipment is employed.

Welfare Work on the Isthmus of Panama.

In view of the unusual and protracted period of hot weather that has oppressed a large portion of this country lately, it is not untimely to mention the fact that the climate during a considerable part of the year on the Isthmus of Panama, while not so hot, produces much the same effect on the human system as that just experienced from the Mississippi Valley eastward. Under such conditions no small measure of the success of the work of the employes on the canal must necessarily depend on the good physical condition in which they keep themselves. The medical staff under Colonel Gorgas is one of the finest ever organized for tropical conditions and may be relied on with perfect confidence to accomplish all that can be expected of a sanitary commission. The health of the employes along the canal will depend, however, on a good deal more than the sanitary condition of their surroundings and the strict medical supervision to which they are subject. The surroundings that tend to keep them contented are equally important in some respects, and the great number of complaints on this score indicate that what is known as welfare work must be looked after on the isthmus if the Americans there are to retain their efficiency. In fact, this has already received the attention of the commission, and a well-known specialist has been engaged to make a thorough report on the situation.

The Engineering Record has lately had an opportunity of securing at first hand some information concerning the condition of the younger engineers and foremen on the isthmus and is convinced that much of the dissatisfaction expressed by some of the people returning from the work can be attributed to two conditions. The first is the lack of experience in real roughing of many of the employes. A considerable number of them were recruited from city positions and went to Panama without any real knowledge of the discomforts of outdoor life on engineering work. They were not suited by temperament or experience for the conditions under which they had to work. They did not find any of the famed luxuries of tropical life waiting for their enjoyment, but were forced to work steadily in places wholly without the opportunities for those kinds of amusement to which they were accustomed to turn for relaxation. The men who had experience in railway camps and on large works in remote localities seem to have been satisfied with the manner in which the organization was being developed, for they knew by previous observation that it takes time and patience to develop all those conditions in an organization of several thousand men which will make each one satisfied that the supreme officials are interested, as they always are, in the welfare of each individual employe.

Another feature of the work that has led to dissatisfaction is the matter of salaries. It was intended, it is understood, to pay from 25 to 50 per cent. more than the average prevailing rate in the United States for the same class of service. The misconception of the conditions of life on the isthmus led a number of young men to accept places rather less important than they were holding at the time, and as a result they found themselves worse off on the canal than they were before. It was all their own fault, but they do not like to acknowledge it, and consequently some complaints have been made that were without any foundation whatever. Still another cause of criticism that has a substantial reason is the lack of provision for the comfort of the men at some of the places on the line where work is now in progress. A few instances of this nature that have been specifically described to The Engineering Record are due to incomplete organization. If the men will make suitable written requests for relief to their immediate superiors, the latter will be only too glad to forward them with an approving endorsement to the higher officials. The success of the enterprise depends so intimately on the enthusiasm of all the employes that any reasonable requests the latter make will be sure of approval. This is particularly true at this time, when particular attention is being paid to the development of a system of organization that will be satisfactory under the local conditions.

The welfare specialist who is visiting the isthmus deserves to receive the full confidence of those upon whom he calls. If he is given this confidence, it is safe to say that every reasonable convenience for making life comfortable and recreation possible on the canal work will be thoroughly discussed. Such an opportunity as he has for making a high reputation in this new specialty has rarely been offered, and it is to be expected that he will endeavor to formulate suggestions which will become a model for use in tropical countries. That there is need for great improvements on the isthmus is admitted on every hand, and that the commission intends to make them is shown by the fact that it has sent a fully competent man to make a careful study on the spot of the conditions about which there has been so much talk.

Notes and Comments.

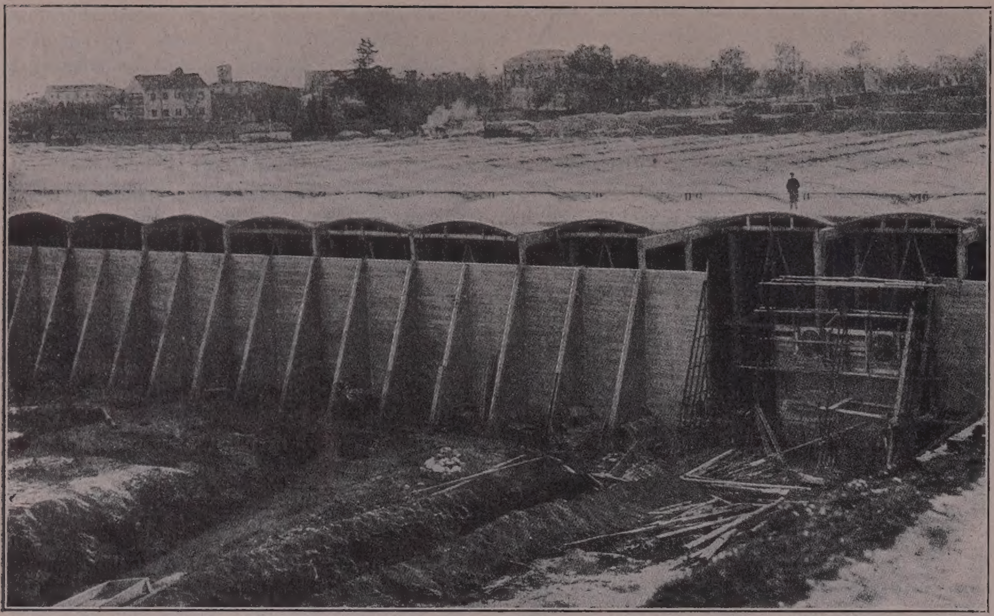
The New Tunnel under the East River to connect the Belmont system of electric railways in Long Island City with those in Manhattan was begun a few days ago. The work will be done under a franchise granted a good many years ago, under which a small amount of work was done in 1892. It was brought to a speedy termination by an explosion which killed a number of workmen. The tunnel will consist of two tubes and will pass under the Long Island R. R. freight yard at Long Island City and under 42d St. in Manhattan.

The Industrial Bureau organized by the Chicago & Northwestern Ry. indicates that this conservative road has recognized the importance of such an organization in building up the business of its territory. A number of other lines have found that a department of this character is of marked value, and, although some of them do not employ the same title, the purpose is the same. Every railway of any importance is in a position to secure early information concerning business opportunities in the district it traverses. Its station agents can keep in touch with their localities and forward to headquarters information that can be utilized to great advantage. For example, on the Chicago & Northwestern system there are flourishing cities and villages requiring many industries to supply the needs of the localities. There are large and small water-powers, important forests of hard and soft timber, and great mineral wealth. The proper development of these resources means a great deal to the company as well as to those who utilize them, and the organization of a good industrial department to help the work along is a really important event in the business world.

A Fight Over Water Rights has been begun by the city of Paterson, N. J., that was foretold many years ago by the late Lebbeus B. Ward. The city has filed in the Court of Chancery a declaration requiring the East Jersey Water Co. to prove its legal right to impound and divert the waters of the Passaic River and dispose of them to other municipalities for the financial benefit of the company. The city claims that the company has no right to divert large amounts of water from the river for use outside the catchment basin of the stream and that this diversion is injuring its rights as a riparian property owner. The city has legislative sanction to discharge its sewage into the river, and this diversion of the water not only diminishes the appearance of the stream, but also threatens to cause, it is claimed, a very unsatisfactory condition of the river below the sewer outlets.

The Glaring Signs which disfigure the landscape of many beautiful places and are such an offense in all cities, cannot be easily abolished. The Metropolitan Park Commission recently endeavored to suppress such a monstrosity near the Revere Beach Parkway. It is 40 ft. long, 7½ ft. high and praises a household utensil in black letters on an orange ground. The owner of the land sold the right to erect this sign, which violates a regulation of the Commission forbidding such things in places where the lettering can be read by people within the park or reservation. This regulation was adopted under the act authorizing the Commission to make reasonable rules governing signs in or near the property in its care. The Supreme Judicial Court of the commonwealth has decided, 74 N. E. Rep. 601, that to forbid such signs, which are not dangerous or immoral, is an infringement of property rights and therefore illegal.

An Interesting Sewerage Problem in several parts of Brooklyn, N. Y., is mentioned in the last report of Mr. Henry R. Asserson, chief engineer of the borough's sewer department. There are a number of depressed pockets where the cellars of the houses are flooded after every heavy rain. When the existing sewers were constructed these districts were not so well built up as now and the streets were macadamized or paved with cobble-stones. Consequently the percentage of the rainfall reaching the sewer inlets was not large, and the run-off was retarded by the surface conditions. Since then these areas have been built up closely, the houses generally touching on the sides, and asphalt pavements have been introduced extensively. In consequence, a much larger percentage of the rainfall reaches the sewers and the run-off is so rapid, owing to the amount of absolutely impervious, smooth surface that the sewers are quickly gorged. To relieve this situation these depressed tracts are to be surrounded with intercepting sewers, which will prevent a large part of the rainfall from reaching the old main sewers. In addition relief sewers are to be built in such a way as to intercept half the run-off carried by the existing system.



Covering of the Third Madrid Reservoir.

THE WATER-WORKS CATASTROPHE IN MADRID.

By T. A. Greenhill, A. M. I. C. E.

THE FAILURE OF THE REINFORCED CONCRETE COVERING OF A SERVICE RESERVOIR.

On the morning of April 8 last, Madrid was alarmed by the report, which rapidly spread through the city, that the covering in ferro-concrete of the third main service reservoir had given way, and that a large number of the workmen engaged in it were killed or injured. Gangs of men were quickly organized and worked night and day to rescue the wounded and get out the dead bodies. In consequence of the covering being in one sheet of concrete, reinforced by the iron network of rods and wires, this operation was exceedingly tedious, and it was not till some days after that the last dead body was recovered, and even the last one still alive was not extricated immediately. Altogether 30 were killed and some 60 injured by the accident. The object of the following article is to give a technical account of the project and the accident, and the few preceding lines of news simply enable some idea to be formed of the importance of the catastrophe.

Madrid is supplied with water by a gravitation system from the Villar collecting reservoir about 90 kilometers away, the water being conducted to Madrid partly by the river course and partly by a covered aqueduct. The aqueduct started from the Ponton de Oliva dam which was the first constructed, but which failed to retain the water as it was built on cavernous limestone. The Villar collecting dam was consequently built farther up the stream, as well as two smaller regulating dams a little above the Ponton de Oliva.

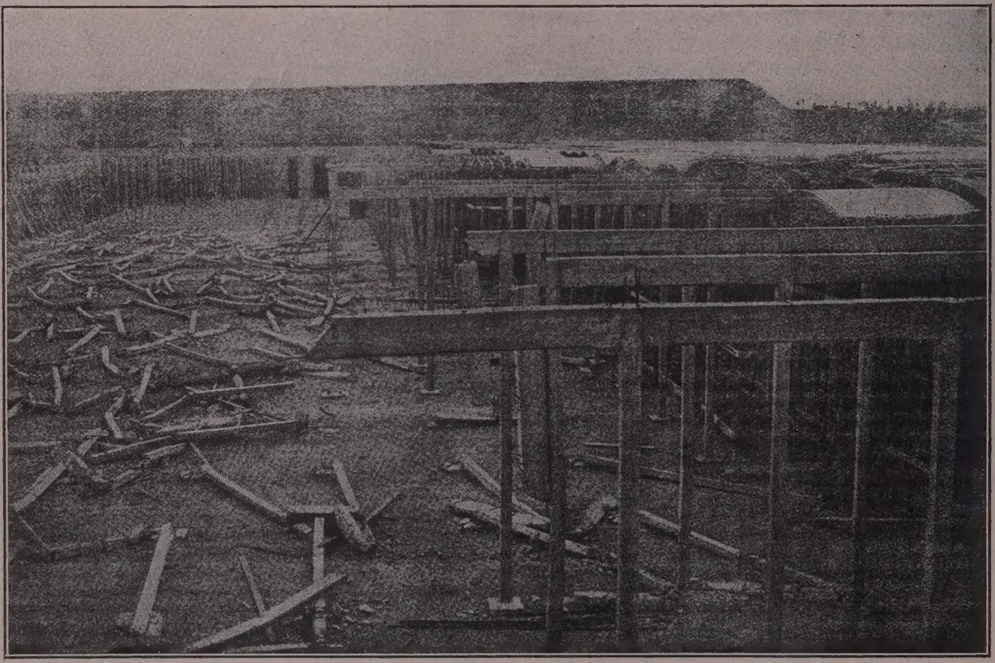
The water runs down the bed of the river from the Villar to the upper one of the two small dams and from thence, by tunnel and covered aqueduct, to the Ponton de Oliva and on to Madrid.

The first service reservoir constructed could contain 58,000 metres cube of water, or 12¾ millions of gallons. This became too small for the increased consumption and a second one, of 182,000 metres cube (say 40 million gallons) capacity, was constructed. At present the water supply of Madrid is dependent upon this reservoir alone, the first having given way.

When it rains a fine red clay is washed into the channel bringing the water from the Villar dam, where it runs along the river bed. The water reaches Madrid the color of chocolate and, as there are no filters nor even the head necessary for them, has to be supplied in that state to the consumers, until by settlement is gradually clears. It is but right to say that this seldom happens.

For these reasons the necessity of a larger service reservoir has been recognized for many years and, after long discussion, the construction of a third was commenced. It is to contain about 480,000 metres cube of water, or nearly 106 million gallons, in four compartments of about 210x85 metres each, with 6.65 depth of water. A partial plan and sections of the reservoir are adjoined.

The excavation for the basin was completed in 1897 and the construction of the brickwork has been carried on up to the present time. The method of covering was under consideration for a long time and at last it was decided that reinforced concrete should be adopted, and in 1901 projects and tenders were invited. In response, at the end of 1902, a number were sent in varying in cost from 4,600,000 down to 1,562,845 pesetas. After considerable discussion the last and cheapest was accepted. The drawings herewith will give a clear idea of the design and the contract was to complete the work in twelve months.



Failure of Columns in First Compartment in June.

Speaking generally the design consists of ferro-concrete columns 0.25 x 0.25 m. and 8.40 m. high to the springing of the arches, spaced 6.02 x 4.03 m. apart from centre to centre. The concrete was of Portland cement, with vertical iron rods of 16 mm. diameter imbedded, which at intervals of 0.25 are tied together with wire. The columns are supported on bases of reinforced concrete into which they penetrate 0.08, and the four rods simply rest on two flat bars imbedded in the concrete base. These columns are constructed by pouring the concrete into moulds of the full height and punned with rammers having handles of the necessary lengths.

The covering consists of parabolic segmental arches of ferro-concrete, 5.77 m. span and 0.58 m. rise, the thickness being 0.05 m., resting on these columns.

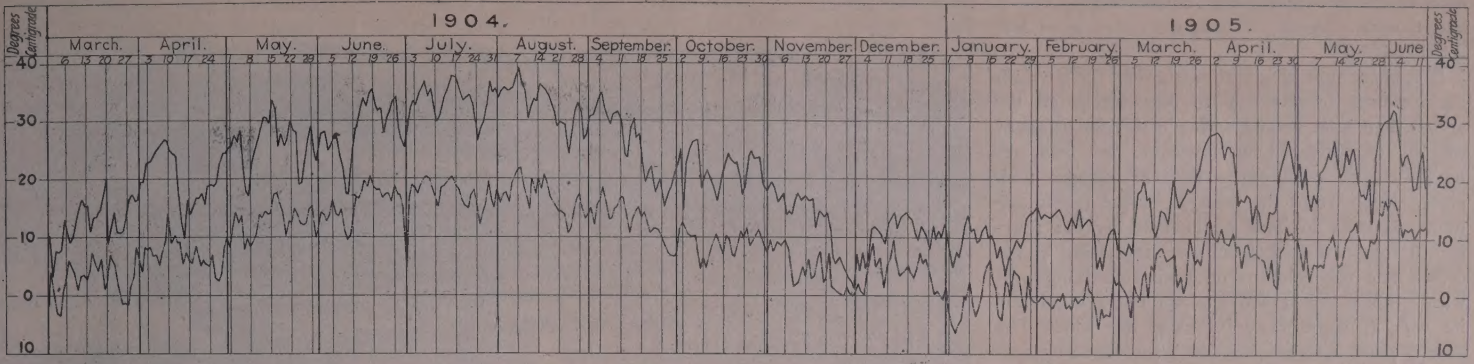
Parallel with the arches the columns are connected, below the springing, by ferro-concrete beams 0.50 m. deep, with a bar 37 mm. in diameter imbedded in position to act as tension member, and three bars at the upper part of 15 mm. diameter in the place of the compression member. These upper and lower bars are connected by vertical and diagonal rods of 4, 5 and 6 mm. diameter. Beyond this there is no tie in either direction between the tall, slender columns, which are in no way attached at the foot to the floor of the reservoir.

Imbedded in the thickness of the arches is a network composed of rods 12 mm. diameter tied with wire 6 mm. diameter, as shown in the drawings.

The Portland cement used was manufactured in Spain and was specified to resist in tension 30 kilos per square centimetre after 7 days and 35 kilos per square centimetre after 28 days, equivalent to 426.7 and 497.8 lb., per square inch respectively. The briquette of net cement is of the size and shape fixed by the French Commission for the Unification of Tests (see Candlot, Les Ciments Hydrauliques, p. 203), with a breaking area of 22.5 x 22.2 mm. or 0.744 square inch area. The cement complied fully with the above tests.

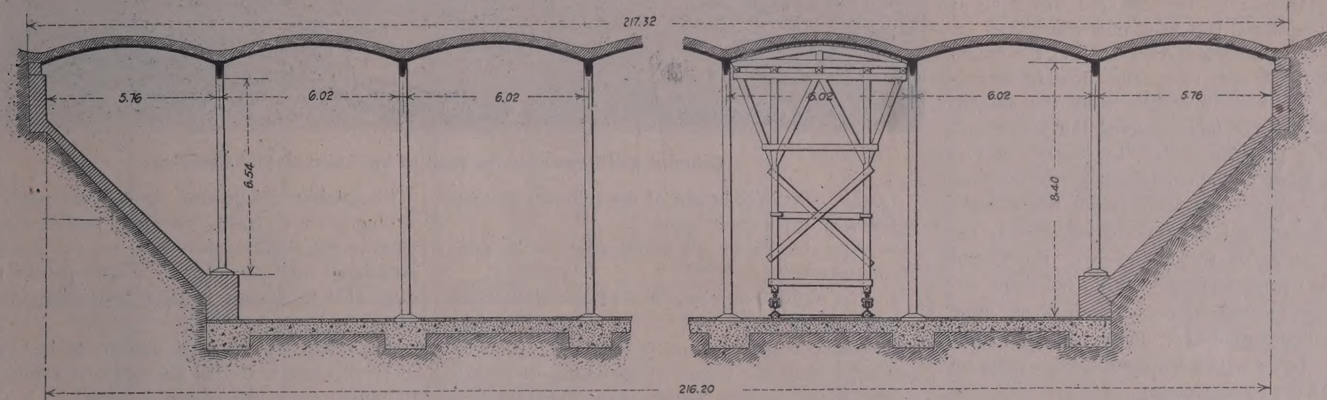
For the columns and arches the concrete was composed of a mixture of 400 kilos, say 802 lb., to a metre cube of sand, which for the remainder of the work, was reduced to 300 kilos or 661 lb.

On the day of the catastrophe the covering of No. 4 compartment was practically terminated; nothing was done to No. 3 and about one-half of



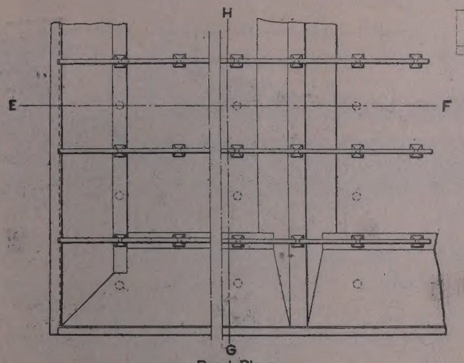
THE ENGINEERING RECORD

Record of Highest and Lowest Temperatures in the Shade in Madrid.

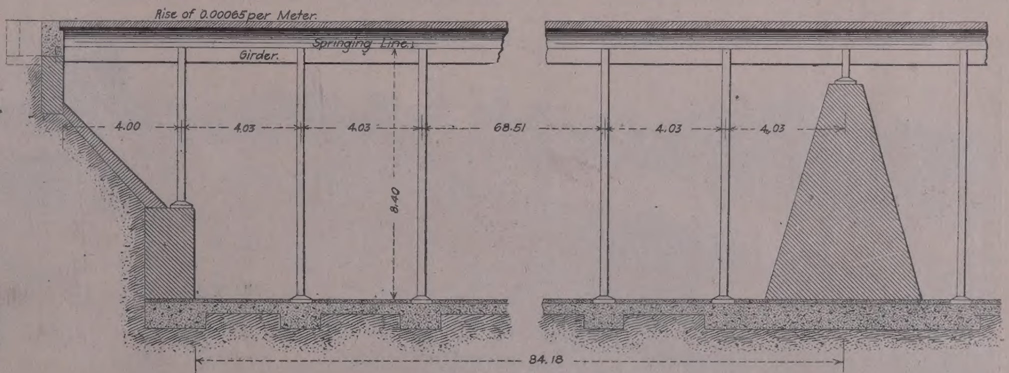


Cross- Section G-H.

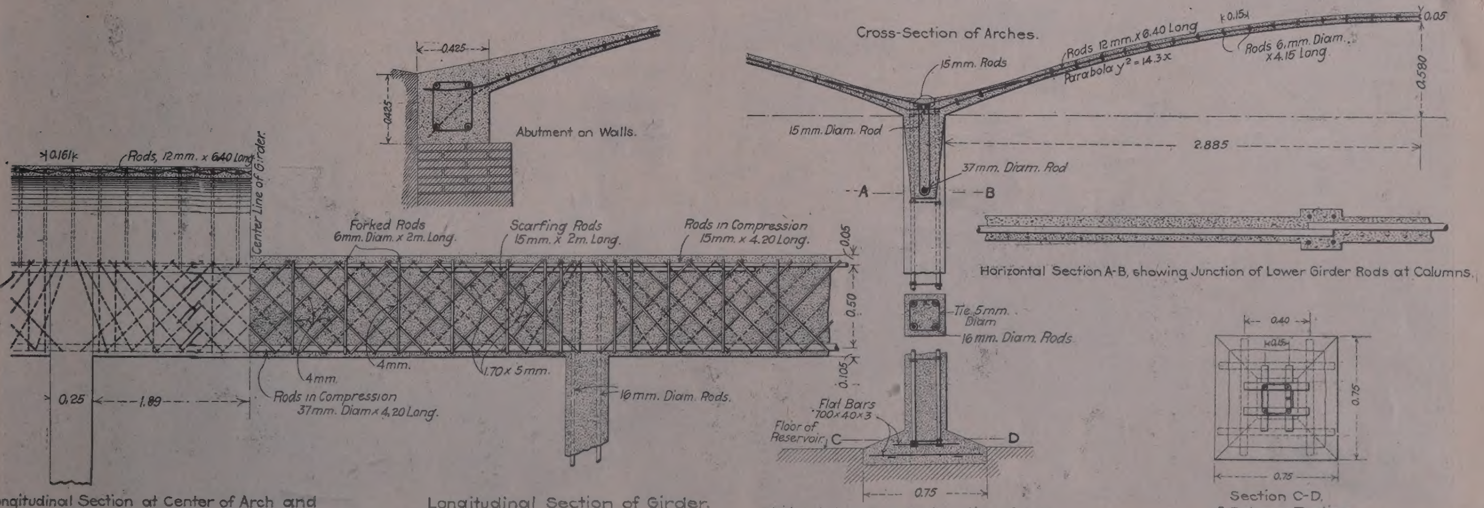
THE ENGINEERING RECORD



Part Plan.



Longitudinal Section E-F.



Longitudinal Section at Center of Arch and Elevation of Girder.

Longitudinal Section of Girder.

Horizontal Section A-B, showing Junction of Lower Girder Rods at Columns.

Horizontal and Vertical Section of Column.

Section C-D, of Column Footing.

THE ENGINEERING RECORD

DETAILS OF ROOF CONSTRUCTION OF THE THIRD MADRID RESERVOIR.

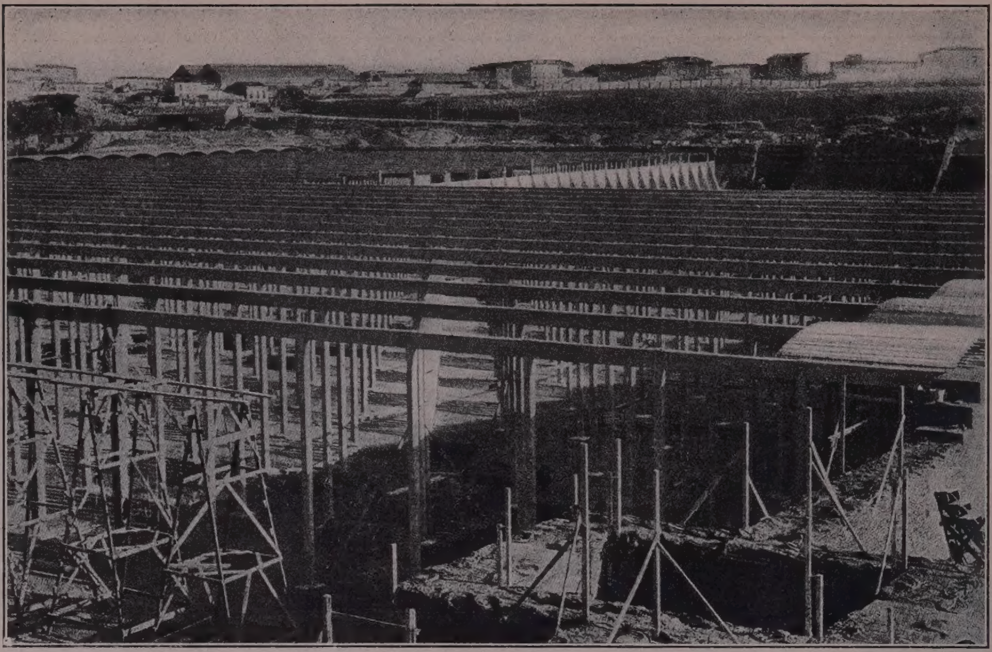
each of the two remaining compartments, Nos. 2 and 1, were covered. It was the covering of No. 4 that collapsed.

It appears that as a test, the cover for a width of 4 metres transversely to butt across all the arches, had been loaded with a thickness of about 0.80 m. of sand, which, however, had been removed. The next day a general collapse took place, which, from the position of the fallen columns, appears to have commenced by the fourteenth row of arches from one side rising at the crown and the columns on each side falling inward. Only a foreman was on the ground and he was at some distance from the spot. The gangers and laborers, besides being taken by surprise, were not capable of making any observations of value which the clouds of dust, in any case, would have rendered difficult.

The first impulse, after the general *sauve qui peut* was to extract the wounded and dead.

One explanation of the collapse advanced is that with the official test load, now considered far too heavy, some arch or arches sank at the crown and the adjoining ones rose, thus allowing the columns between them to deviate from the perpendicular. When this had occurred the whole collapsed like a pack of cards. In support of this there were many of the columns after the accident showing a sufficient deviation from the straight to allow the vertical pressure to fall outside the base. The ends of the arches over the sloped ends of the compartment which did not come entirely to the ground, were some of them quite flat, while others were quite pointed like the ridge of a roof. There were even some similar cases on the floor of the compartment.

Without advancing any argument upon the causes which may have contributed to the catastrophe, attention can be called to the foregoing remarks as well as to the following points:



Columns and Beams for the Roof of the Third Madrid Reservoir.

1.—The excessive height of the columns as compared with their dimensions.

2.—The absence of any attachment to the floor of the reservoir.

3.—No increase in their dimensions at the foot similar to a tree.

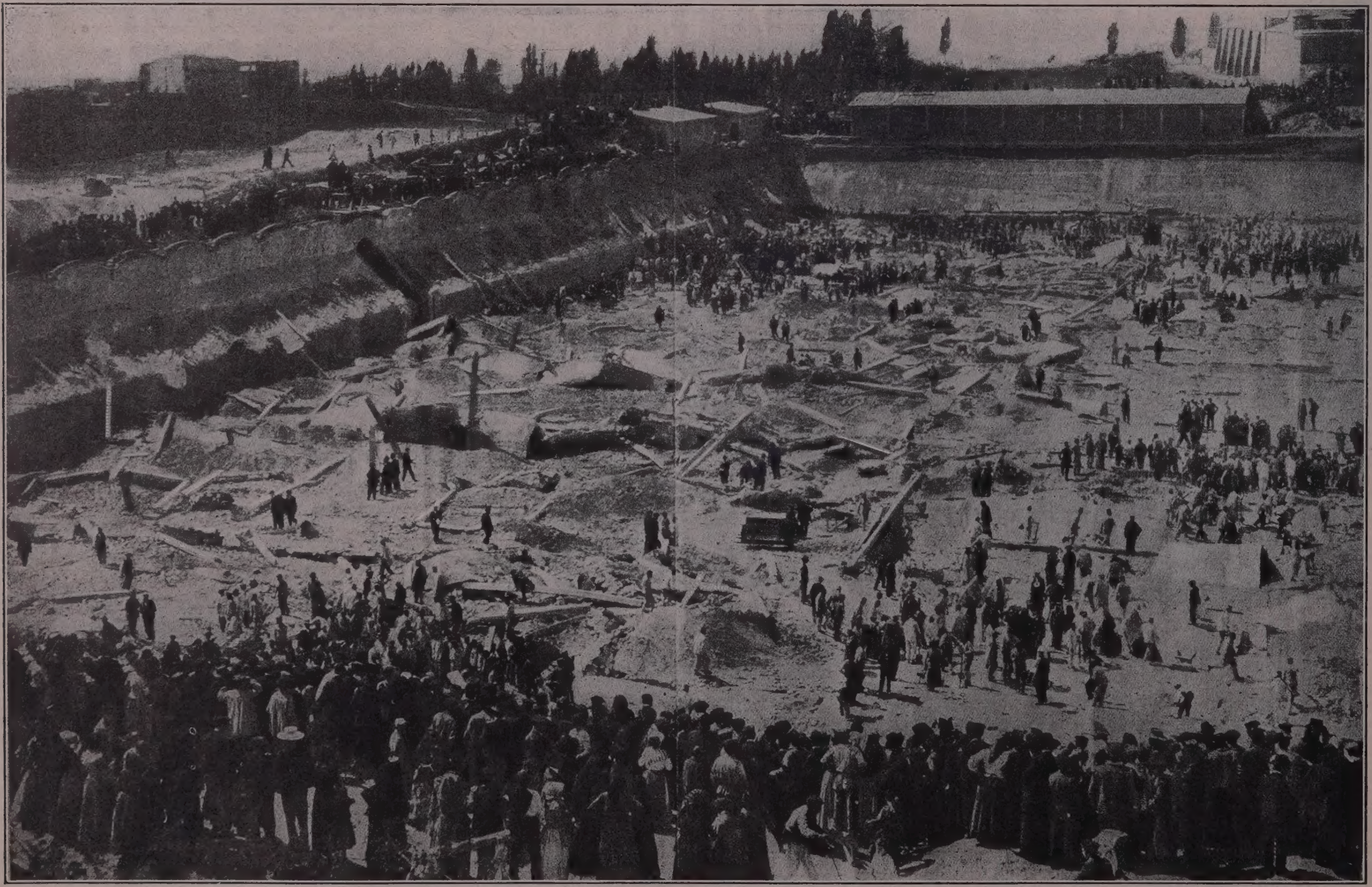
4.—The complete absence of any tie in either direction, except the beams at springing of arches, in the shape of open lattice work, horizontal or diagonal ties, or the complete filling in as abutment piers of a certain number of the spaces between the columns.

5.—The effects of temperature on the work.

The stability depended upon every part maintaining perfect rigidity vertically and horizontally without the slightest deviation, for as soon as any movement took place in any single member others were able to deviate in their turn, bringing on a general collapse.

The quality of the work appears to be excellent in every respect, so that the cause of failure must be sought for in the design.

The engineers of the "Canal" in their report on the tenders pointed out the fallacy of the theories on which the calculation of the stability of ferro-concrete structure are based, and insisted



View of the Third Madrid Reservoir Taken Immediately after the Collapse of the Roof.

upon the necessity of previous trials, of one or more of the systems, being carried out before final adjudication. This advice was not followed.

Since the above was written a fresh development has presented itself which throws considerable light upon the question.

It is stated at the commencement of the article that about one-half of each of compartments 1 and 2 was covered, the arches having been commenced at opposite sides and were to meet over the division wall between the compartments. The whole of the columns and the beams were, of course, completed. The construction had been commenced in March, 1904, and, as stated at the beginning of this article, the collapse of the covering of No. 4 compartment took place on April 8 last.

During the latter part of the month of May the beams of compartments Nos. 1 and 2 where the arches had not been completed, so that they were exposed to the direct rays of the sun and were not tied in place by the arches, commenced to dilate to such an extent that on June 2 on visiting the work the visible portion of them had become serpentine in plan, in some cases extending over the whole length exposed, and in other confined to four or five spaces between columns. In these latter cases the deviation from a straight line was as much as 0.50 or 0.60 m., judging from the dimensions of the columns, for it was absolutely prohibited to enter the compartment and approach the part of the work thus showing signs of failure. The heads of the columns remained, of course, attached to the beams, so that the columns were to a corresponding extent drawn out of the perpendicular.

As the beams are constructed continuously over the two compartments they have a total length of 178 m., and it is perfectly evident that the question of expansion and contraction caused by variations in temperature had never been taken into account in preparing the design.

Two days after writing the above, as was to have been expected, the deformation of the beams brought down some 200 of the columns in the first compartment, and it may be anticipated the destruction will continue until the remainder comes down. For the moment, rain has set in, causing a fall in the temperature and the destruction has come to a stop.

A diagram is annexed showing the highest and lowest temperatures every day since the works of the cover were commenced, which plainly indicates the rise at the commencement of April when the first collapse took place and at the beginning of June when the second one occurred. It would therefore appear clearly demonstrated that the cause of the failure proceeded almost entirely from expansion of the reinforced concrete caused by elevation of temperature for which no allowance was made in preparing the design.

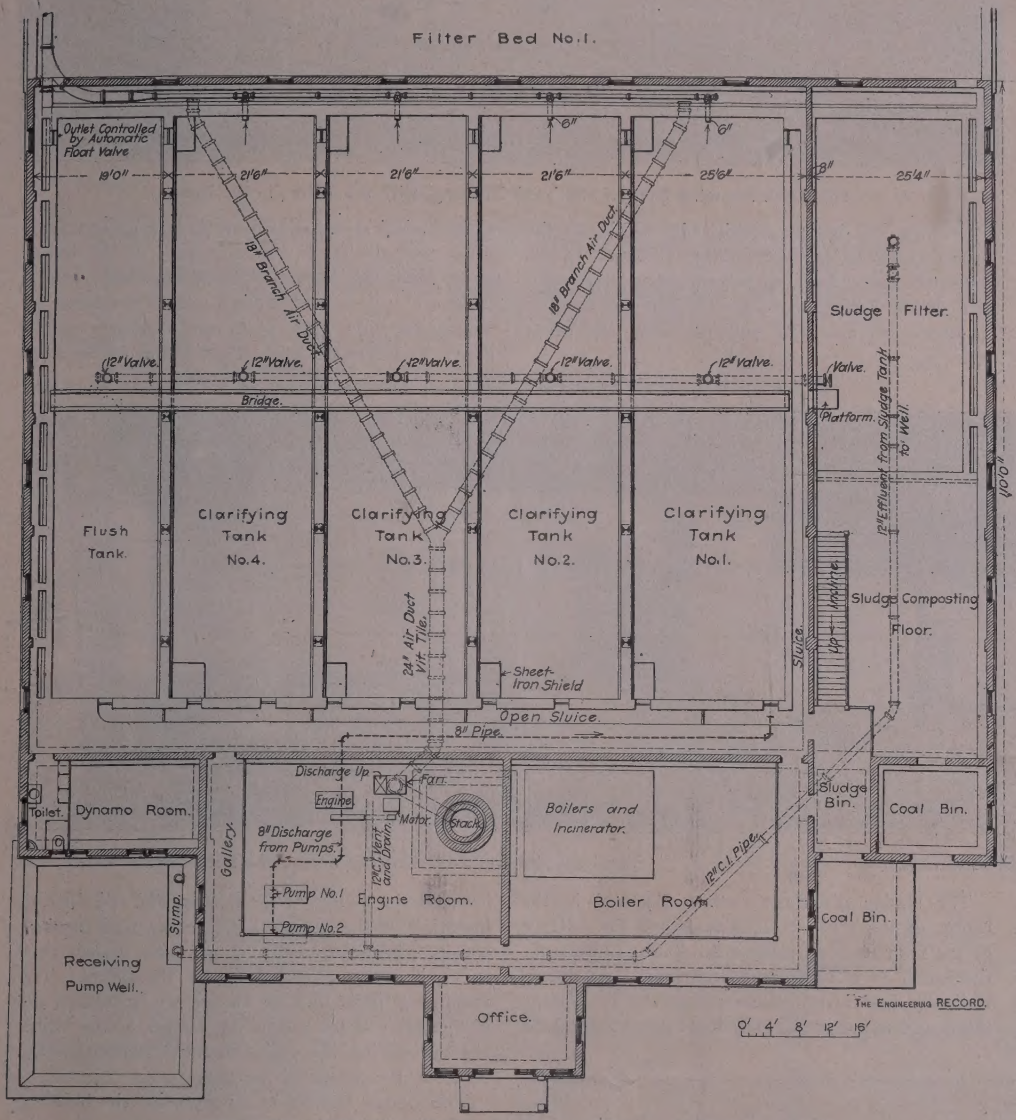
GAS PRODUCERS and centrifugal pumps from R. D. Wood & Co. and gas engines from the S. M. Jones Co. will be used at two of the pumping stations of the New Orleans drainage works to handle the constant dry-weather flow. The storm water will be pumped by the electrically operated apparatus already installed, which will be operated intermittently as occasion requires.

Sewage Disposal at Elmhurst, N. Y.

A sewage-disposal plant designed to treat 1,000,000 gal. of sewage per day by sedimentation and intermittent sand filtration has recently been constructed for the Borough of Queens of New York City. The plant is on a much traveled highway leading inland on Long Island from Long Island City, and at the edge of a broad salt marsh connected with an arm of Long Island Sound, the only water course near it being a small stream flowing into the sound. It consists of a pump well and pumps, four concrete clarifying or sedimentation tanks, a flush tank and a sludge filter, all in a one-story brick building, with three open sand filters, having a total area of one acre, in connection with the building at the rear.

Proposals for the construction of a sewage-disposal plant to purify 1,000,000 gal. of sanitary sewage per day, so that the effluent from the plant would not create a nuisance when discharged into the small stream adjacent to the site, were invited by the Department of Sewers of New York City. It was stipulated that the bidders submit plans for the plants which they proposed to construct and that the successful bidder be required to operate his plant for six months when it was completed, fulfilling the requirements of purification successfully during that time, before the plant would be accepted by the city. The plans submitted by Mr. Chas. Hart, of Brooklyn, N. Y., which were modeled after the Mitchell system of clarifying tanks, followed by sand filtration, controlled by the International Sewage Disposal Co., of Boston, Mass., were accepted. Mr. Hart has recently completed the construction of the plant, and it is now being subjected to the six months' operation test.

The brick building at the front of the plant is divided into two parts: a low, flat-roofed portion over the tanks at the rear and a higher portion in front, with a slate roof supported on trusses. The arrangement of the interior of the building is shown on the accompanying general plan. The sewage is delivered to the plant in a 24x32-ft. brick pump well, built in connection with the front portion of the building. The bottom of this well is 10 ft. below mean high-water level in the adjoining creek and 15 ft. below the floors in the building. Two 9x12-in., low-service, direct-acting, duplex Worthington pumps elevate the sewage from the pump well and discharge it in a cast-iron pipe leading to the clarifying tanks. The pumps are in a 29½x41-ft. engine room at the front of the building, together with other mechanical equipment required in the operation of the plant. The boilers which furnish steam for the operation of this equipment are located in a boiler room adjoining the pump room at the front of the building.



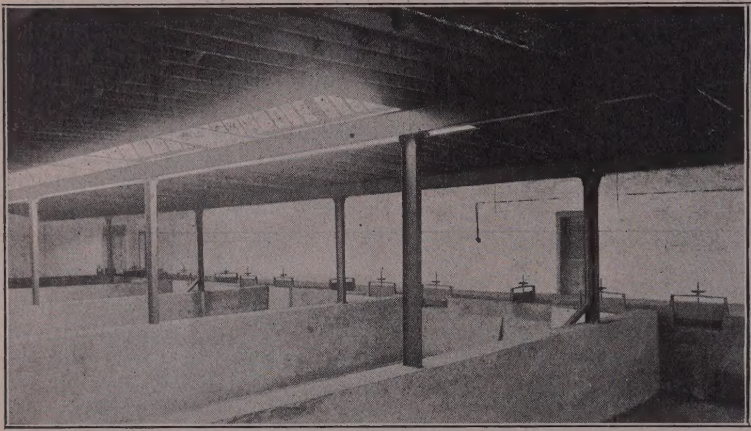
General Plan of Pumping Station and Tank Building at Elmhurst, N. Y.

The four clarifying tanks and the flush tank are built of concrete and are arranged in a row in a portion of the building at the rear, which is separated from the remainder of the building by brick partitions. Their relative arrangement is shown in the general plan. The clarifying tanks are each 19x82 ft. in plan at the bottom and 5 ft. 6 in. deep. The flush tank is 14x82 ft. in plan and the same depth as the clarifying tanks.

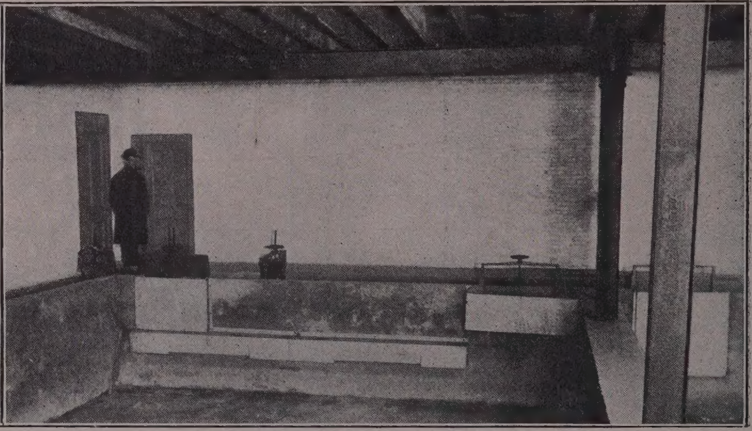
The discharge pipe from the pumps is connected with an open channel built in the top of the concrete wall at the front of the tanks. This channel extends the width of the row of tanks, with an inlet and outlet opening from it into each clarifying tank and a single opening into the flush tank, the openings all being controlled by sluice gates. In the top of the division walls between the tanks at the end farthest from the channel are openings, also controlled by sluice gates, which connect the adjacent tanks. The flow may thus be diverted from any tank or maintained from one tank to the next, the operating gates being arranged so any one tank may be thrown out of operation without affecting the other tanks. The outlet gates are protected by partially submerged vertical shields to prevent the flow through them being drawn immediately from the surface of the liquid in the tank. The shields are made of sheets of galvanized iron, bent so as to form with the side walls of the tank a protected space about 3 ft. square at each opening. The sewage is directed from one end of each tank to the opposite end, then directly into the next tank or out through the open channel at the end of the tanks until it finally reaches the flush tank. It is automatically discharged from the flush tank, at intervals, through a 16-in. pipe leading to the filter beds.

The Brick Pumping Station and Tank Building, with the Filters in the Rear.

The clarifying tanks are designed to remove the solids in suspension by passing the sewage through the tanks at a velocity sufficiently slow to permit the heavier matter to be settled out and the lighter materials to rise to the surface. The inlet and outlet openings are arranged to facilitate this process, and a sludge discharge outlet is built in the floor of each tank, through which the sediment may be removed. A stilling chamber is placed around the inlet opening to the first tank, which is close to the end of the discharge pipe from the pumps. This chamber is formed by galvanized sheet iron arranged in a manner similar to the arrangement of the shields around the outlet openings. It is connected at the bottom with a covered, horizontal, galvanized-iron trough extending nearly across the end of the tank. A vertical, sheet-metal diaphragm is placed longitudinally in this trough, with a space between the top of the diaphragm and the cover of the trough. The outlet from the trough is through narrow slits along the lower outside edge of it, so the liquid which enters the stilling chamber passes down into the trough, up over the diaphragm and then to the outlet openings. A similar chamber is placed on the inlet openings into the other tanks.

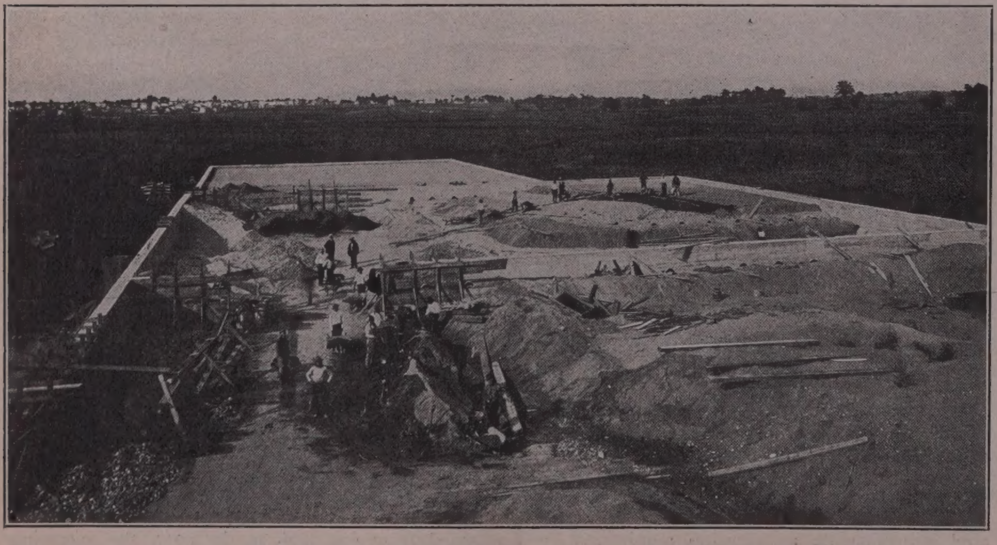


The Open Distributing Sluice at the End of the Tanks.



The Inlet and One Outlet at the End of the First Tank.

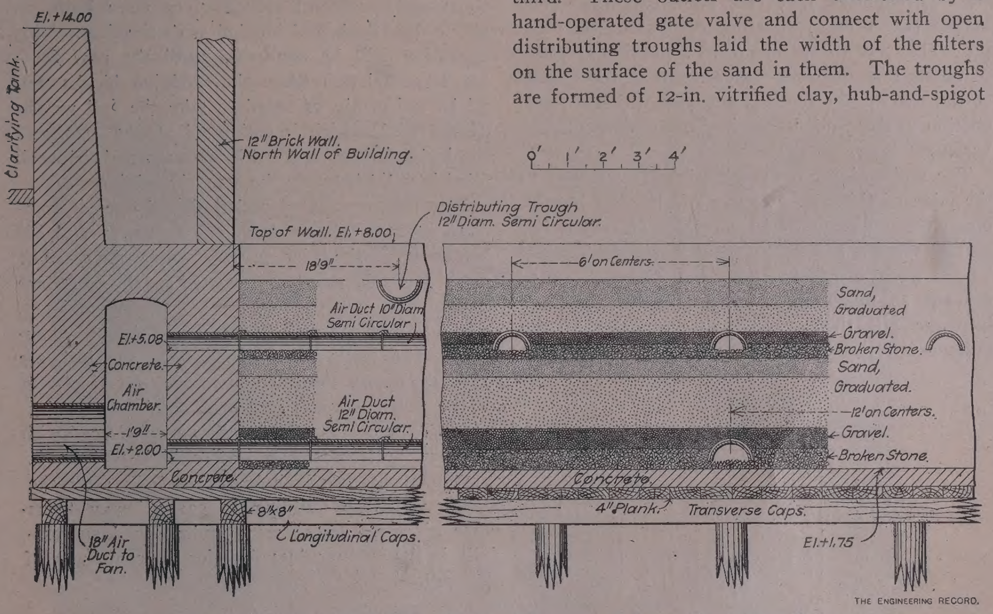
The sludge discharge outlet is placed in the center of the floor of each tank and the surface of the floor inclined toward it. These outlets are connected to a 12-in., cast-iron pipe, laid longitudinally under the concrete floor to the sludge filter, and are controlled by hand-operated valves, with vertical stems extending up to a narrow platform over the tanks at the middle of the building. When the sludge is to be removed from a tank, the tank is first thrown out of operation by closing the sluice gates at its inlet and outlet openings. The comparatively clear liquid in the tank between the sludge at the bottom and the floating materials on the surface is then drawn off through a 6-in. pipe at the rear of the tank, which connects with the main leading to the filters. The remaining liquid and the sludge are turned on the sludge filter in the adjoining portion of the building by opening the valve on the sludge-discharge outlet at the center of the tank.



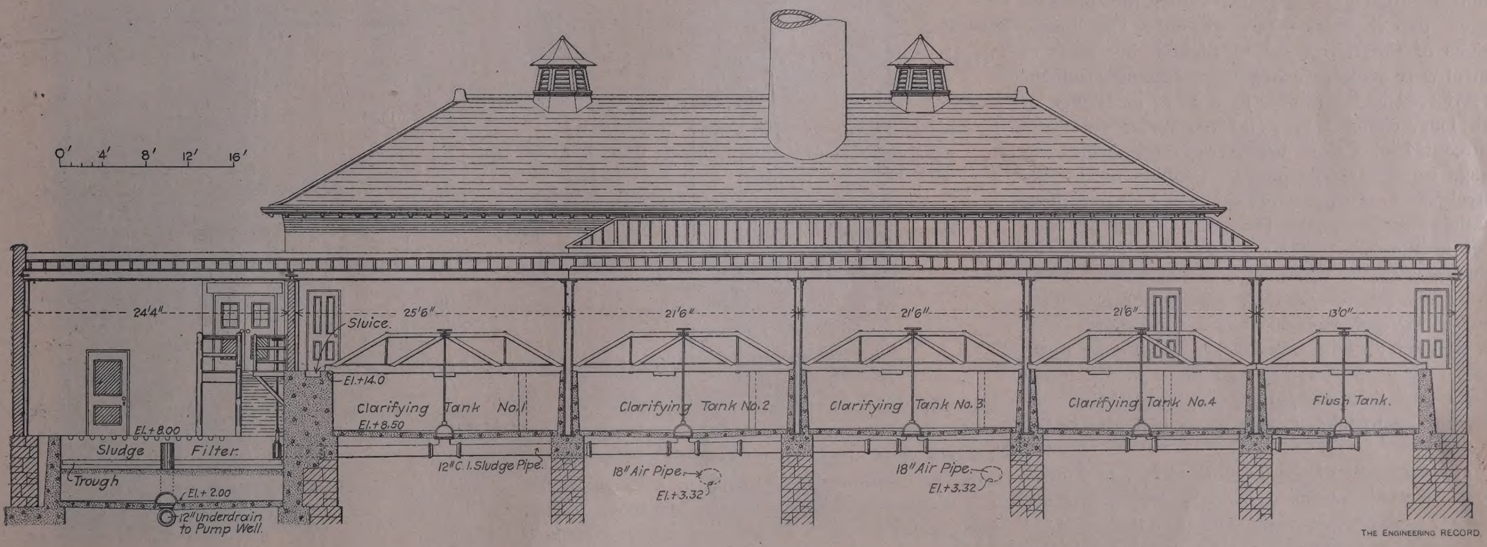
The Filters during Construction Showing the Upper Row of Air Pipes in the Second Bed.

The sludge filter is in a portion of the building 24x82 ft., which also contains a concrete platform, on which the sludge intercepted on the surface of the filter is mixed with finely divided boiler fuel and the mixture burned under the boiler in the front of the building. The filter is 20x50 ft. in plan and is in the rear of the concrete platform, with its floor 5½ ft. below the floor of the tanks. The filtering material is made up of 3 ft. 3 in. of 3 to 4-in. stones and coarse sand, the larger stones over the concrete floor at the bottom and the sand at the top. Over the sand is placed about 4 in. of the fuel that is used in firing the boiler furnaces, buckwheat coal being used at present in the operating test.

The 12-in. cast-iron inlet to the sludge filter from the tanks enters about 13 ft. from the front end of the filter, just above the surface of the filtering material. It discharges into a transverse trough, from which the liquid overflows on the filter. The outlet from the filter is a 12-in. cast-iron pipe, laid beneath the floor and extending back to the receiving pump well. The connection with this outlet is made at the center of the filter by a 12-in. tee opening into the filter at the floor line. The filtering material is excluded from the open end of this tee by a hemispherical screen. The pipe is extended 4 ft. beyond this floor-level connection and an overflow formed by an elbow extending up above the filtering material. The surface of the concrete platform at the end of the filter is about 3 ft. above the surface of the filtering material. The platform joins a fuel storage room and is connected by an incline with the boiler room. The contents of a tank are discharged on the filter and the liquid allowed to pass through the filtering material to the underdrain and through it to the pump well. The sludge that is intercepted on the surface of the filter is then scraped off, mixed with fuel on the platform and burned in the boiler furnaces.



Diagrammatic Part Longitudinal and Transverse Sections of Filter Bed.



Cross-Sectional Elevation of Clarifying Tanks, Flush Tank and Sludge Filter.

The plant is ventilated by a system of ventilation ducts connected with a 36-in. Buffalo Forge Co. fan in the pump room. This fan is driven by a small steam engine, furnished with steam from two boilers, built by the Gem City Boiler Co., Dayton, O., over the sludge-incinerator furnaces, and discharges into an 87-ft. brick stack, with which the breeching of the boiler furnaces is also connected. The receiving pump well is covered with a tight roof provided with a skylight, and is connected by a duct with the ventilating fan.

The three filters at the rear of the building are arranged in a row, one bed joining the building and the other two beyond. They are built with concrete floors, side and division walls resting on a pile foundation covered by a 4-in. plank floor on a grillage of 8x8-in. caps. The first bed is 133 ft. wide and 113 ft. 7 in. long; the second is the same width as the first and 114 ft. 7 in. long, and the third is 100 ft. wide and 153 ft. long. The 16-in. outlet to the filters from the tanks is laid at the surface of the filters on concrete piers at one side, with five 6-in. tee branch outlets into the first filter, five into the second and eight into the third. These outlets are each controlled by a hand-operated gate valve and connect with open distributing troughs laid the width of the filters on the surface of the sand in them. The troughs are formed of 12-in. vitrified clay, hub-and-spigot pipe, split in half along the longitudinal center line and laid with open joints.

The filtering material in the first two filters has a compound arrangement, with a total depth of 5 ft. 3 in., while the third filter is a simple one, with about 3 ft. of filtering material in it. The upper 18 in. of the first two beds is graded sand, the next 4 in. graded gravel, and below that 5 in. of 2-in. broken stone. Lines of air ducts, formed by splitting 10-in. vitrified hub-and-spigot pipe along the longitudinal center line, are placed longitudinally in each filter on 6-ft. centers, with their convex sides up and their lower edges about 2 in. above the bottom of the layer of broken stone. The 10-in. air ducts extend the full length of the two beds and open to the air above the third bed by passing through the division wall between the second and third beds. At the opposite end they connect with an air chamber, 1 ft. 9 in. by 4 ft. 9 in. in cross-section, which is built the width of the building in the concrete wall at the rear of the tanks and the footing of the rear building wall. This chamber is connected to the fan in the pump room by an 18-in. air duct at each end, which joins to a 24-in. duct, all laid with tight joints under the concrete floors of the tanks.

Below the 5 in. of broken stone in which the longitudinal 10-in. air ducts are laid is 18 in. of graded sand, under which is 12 in. of graded gravel, and at the bottom 6 in. of 2-in. broken stone, forming with the material above one filter over the other in the same bed. Lines of air ducts formed of half 12-in. pipes are laid in the bottom layer of broken stone in the same manner that the upper 10-in. ducts are laid. These lower air ducts are on 12-ft. centers and are laid longitudinally with their lower edges 3 in. above the floor line of the filter. They connect with the ventilating fan in the pump chamber through the same air chamber that the 10-in. ducts connect with it, but they extend under all three beds, with their inlet openings in an air chamber built the width of the third bed in its rear wall. The 3 ft. of filtering material in the third filter has the same arrangement as the lower 3 ft. of material in the other two filters.

The underdrainage of all three filters is the layer of coarse stone at the bottom. The liquid flows from the first filter to the second and thence to the third through half 12-in. clay pipes laid on 12-in. centers, with their convex sides up, in the division walls between the beds. The final discharge from the third bed is through 12-in. pipes leading from an effluent chamber built the width of the bed in its rear wall.

The swampy nature of the site occasioned considerable difficulty in the construction of the plant, and quicksand interfered materially in building the pump well. The concrete used in the walls and floors of the tanks and filters was mixed wet in the proportions of 1 part Lehigh Portland cement, 2 parts sand and 5 parts broken stone. It was spaded along the forms as it was laid, but no waterproofing was used. The sand for the concrete and that used in the filters was obtained locally.

ELECTRICALLY DRIVEN ROLLING MILLS are described in a paper by K. Ilgner in the "Zeitschr. Elektrotechn.," of Vienna. The reversal of the machinery is effected by changing the direction of the field in the main dynamo, a sufficient interval being allowed to bring the motors to rest.

Underpinning a 70-Ft. Wall without Temporary Supports.

The 58x105 ft., 18-story addition at Nos. 7 and 9 Frankfort St., to the Tribune Building, Park Row, New York, will cover a site previously occupied by old-fashioned brick buildings from one to four stories high, with their foundations and cellar excavations carried down about 8 ft. below the curb. The soil here is chiefly composed of fine dry sand and gravel which runs badly when excavated, and is interspersed with layers of loamy material from 1 to 8 ft. thick which will stand at a moderate angle. Adjacent to the site in the rear is the 5-story wall of the Press Building, extending to the lot line, and having its foundations about 14 ft. below the curb. On one side of the lot the building at No. 11 Frankfort St. has a wall 70 ft. high with a rubble stone footing 10 ft. below the curb.

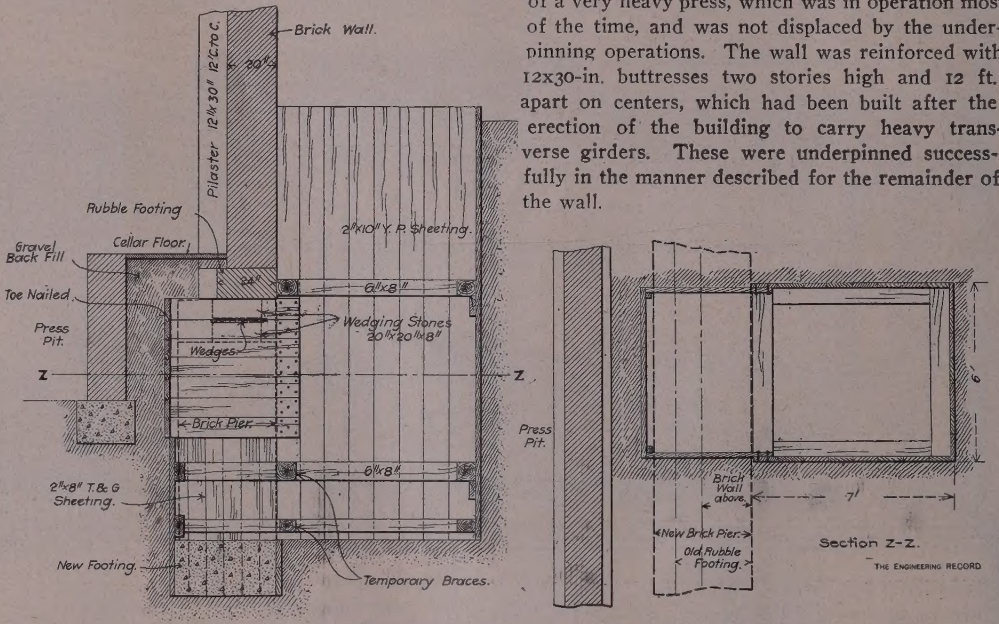
The new building will have a general excavation about 18 ft. below the curb, with the grillage footings occupying a large portion of the area and carried down to a depth of 23½ ft., but not reaching to ground-water level. Excavation is made by hand, commencing at the rear of the lot, and the spoil is passed up to the street and removed in wagons. The excavation adjacent to the old walls was carried down to about 4 ft. above their footings, and the latter were underpinned before the general excavation was carried farther.

The adjacent 11-story wall of the Tribune Building was not underpinned, but its foundations were secured above the level of the bottom of the new excavation by the system of permanent sheet piles, illustrated in The Engineering Record of July 15. Before the piles were driven the wall was shored by four inclined timbers 70 ft. long, with their feet 10 ft. clear of the wall on timber cribbing, which distributed the pressure over 6x8 ft. areas of the ground. The dimensions of the shores varied slightly, but most of them were made with single 14x12-in. pine timbers, reinforced in the middle by a 10-12 in. timber, 45 ft. long, clamped to it on the under side with three 1¼-in. U-bars with screw ends, which engage wooden saddle pieces. Cushion blocks and steel plates were put under the loop ends to provide satisfactory bearing on the timber. Recesses were cut in the base of the wall to receive the full thickness of the upper ends of the shores, which were cut square and took bearing through horizontal, beveled, wooden shims. The shores were at first set up with screwjacks, which were operated to give them a thrust of about 35 tons each. They were then wedged securely against the cribbing, so as to take up this stress and release the jacks.

The basement of the building at No. 11 Frankfort Street is occupied by very heavy printing presses, which run night and day for a large portion of the time, and also contains rolls of paper, which load the floor heavily. Admission to this basement was refused the contractors and it became necessary for them to execute the underpinning wholly from the outside. In order to do this irregular pits about 6 ft. long, parallel with the wall, and 7 ft. wide, perpendicular with it, were sunk close to the face of the wall in two or three places with a considerable interval between them. These pits were sheeted in the usual manner with 2x10-in. square edge yellow pine planks braced with 6x8-in. waling pieces. The pits were commenced at the level of the old cellar floor, about 6 ft. above the footings of No. 11, and were carried down to a total depth of 14 ft., which was about 3 ft. above the bottom of the new footing there.

After the excavation was carried below the bottom of the old footing some of the material underneath the latter was allowed to flow into the pit and after the excavation was completed the material was cautiously removed under the old footing for the full width of the sheeted pit and to a distance about 1 ft. behind the rear edge of the old footing. This was a delicate operation and care was taken to sheet this tunnel excavation by means of 2x8-in. tongue-and-groove horizontal boards set edgewise in vertical planes, with the tongues downward. The first board set was parallel with the wall, and its upper edge was flush with the bottom of the old footing. It was carefully worked into position and secured there by horizontal boards at each end perpendicular to it, with one end abutting against it and secured by a vertical corner cleat, while the other end was nailed across two vertical sheeting planks in the main pit. This left an opening with a maximum width of about 1 ft. over the upper edges of the boards at the rear of the footing, through which a small portion of the sand flowed in from underneath the basement floor.

The undermining excavation being continued to the edge of this upper course of sheeting boards, opportunity was made to carefully place another set of similar boards to form a second course. These were inserted with great care, so as to prevent as much as possible the flow of sand into the pit, their grooves were fitted to the tongues on the lower edges of the first course and the two courses were further united by toe nails driven through the joints. Successive courses were thus built underneath as the excavation was continued to a depth of 5 ft. below the old footing. Then, sufficient headroom having been secured, 2x8-in. tongue-and-groove boards, 6 ft. long, were brought in and worked into a vertical position and driven down around the sides of the unlined excavation as fast as the material was removed.



Underpinning without Needlebeams.

By this means the excavation was carried down without inflow of the sand to a depth of 11 ft. below the old footing, where sub-grade was reached. From this point the sand flowed in in a flat slope from the higher bottom of the main excavation and was retained by a single board set up edgewise in the plane of the outer face of the wall, as indicated in the sectional diagram. The horizontal bracing was completed around the finished excavation and the bottom being leveled, concrete was filled in to a depth of 3 ft. to form the new footing.

Fine gravel was then filled in to the open space behind the old footing, and the upper horizontal boards and brick piers were built on the new footing across the full width of the pit and carried up nearly to the bottom of the old footing, where they were capped with two courses of single 20x20-in. bluestone templates, 8-in. thick, dressed on the horizontal surfaces. These were set on the center pier and were wedged apart with steel wedges. A 15-ton hydraulic jack was operated on each side of each pier to force the latter to good foundation bearing and take as much weight as possible from the old wall. While they were in operation the wedges were driven up tight and afterwards each hydraulic jack was replaced by a pair of 10-ton screwjacks.

After the first set of piers had been built in this manner, excavations were made adjacent to them and a second set of piers were built, as above described, and bonded with the first. This operation will be continued until the new footing is completed, when the wedging blocks will all be uniformly adjusted to take the full weight of the wall, which is estimated at 500 tons, and the jacks will be replaced by permanent brickwork filled in solid between the sets of wedging stones.

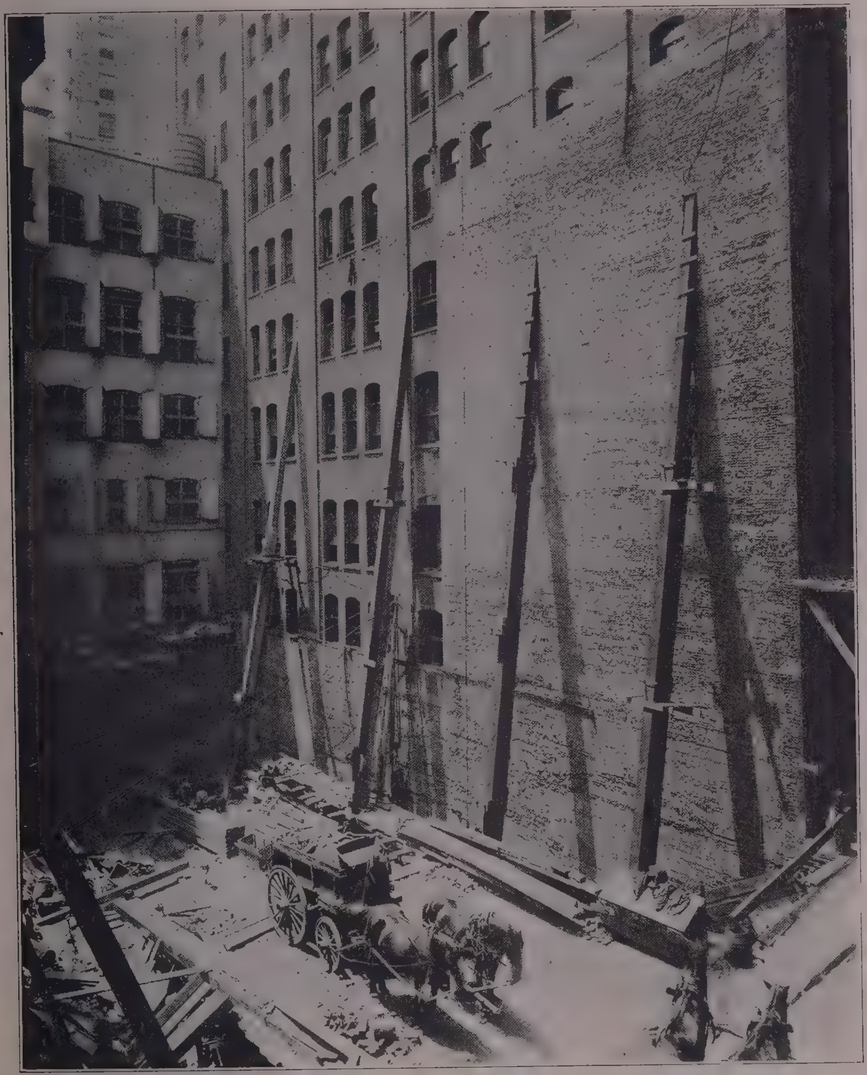
Five men excavated and timbered one pit complete in two 8-hour days. One mason and his helper built the pier in two more days. The work was somewhat complicated by the existence at one point of a press pit about 5 ft. deep and 3 ft. 4 in. clear of the wall, as shown in the cross-section. The walls of this pit carry the bedplate of a very heavy press, which was in operation most of the time, and was not displaced by the underpinning operations. The wall was reinforced with 12x30-in. buttresses two stories high and 12 ft. apart on centers, which had been built after the erection of the building to carry heavy transverse girders. These were underpinned successfully in the manner described for the remainder of the wall.

The foundations are being built by D. C. Weeks & Son, general contractors, and the work above described is being executed by Miller, Daybill & Co., Inc., shorers and contractors, Brooklyn, N. Y., under the supervision of Mr. Charles E. Holme of that firm, and Mr. L. Muchemore, C.E., in charge of the work.

Quick Replacement of a double-track bridge on the Baltimore & Ohio R. R. was recently accomplished at a structure over Crum Creek on the Philadelphia division. The new bridge has two pin-connected Pratt trusses 163 ft. long, 34 ft. deep and 28½ ft. apart on centers, which were erected on trestle falsework alongside the old structure. The old and new spans were connected together, jacked up and simultaneously moved laterally with rollers on tracks laid on trestle extensions to the abutment piers until the new span replaced the old on the center line of the double track. The actual time occupied by the movement of the bridge was 6½ minutes. The fact that the operation was not considered particularly unusual by Mr. J. E. Greiner, engineer of bridges and buildings of the company, is an indication of the present condition of structural work on that road which is interesting in itself.

Sewage Disposal at Hampton, England.

A few weeks ago the Association of Managers of Sewage Disposal Works, a comparatively new British organization, met at Hampton and visited the disposal works in that city. These works were explained to the visitors by Mr. Hughes in a paper reviewed in the "Surveyor," from which the following notes are taken. The district of Hampton is, for sewerage purposes, divided into eight drainage areas, or gravitation units. Each unit has, situated at the lowest part, an ejector station, built below the surface of the roadway. These ejector stations contain 15 Shone ejectors, which are duplicated in seven stations. The sewage from each drainage area flows by gravitation into the ejectors, which automatically discharge their contents through a rising main to the outfall works.



Shores Bracing 11-Story Wall of Tribune Building.

The level of the invert of the lowest sewer is 14.89 ft. above ordnance datum; this point is 2.3 miles distant from the works. The invert level of the rising main in the screening chamber is 69.75 ft. above ordnance datum, so that there is a rise of 54.86 ft. between the two points. The sewage, however, from this lowest point is not lifted into the screening chamber direct, but is delivered into an intermediate station, where it is again raised by ejectors. The sewage is raised direct to the works from five stations, the greatest total lift from these being 41.5 ft., requiring 28 lb. per square inch of air pressure.

The screening chamber was formerly open, and objectionable odors were emitted from it, which were due to the fact that the sewage was in the rising main for at least six hours, and for a much longer period when the flow was less. It was thought advisable to cover it in, and to ventilate it as a part of the general ventilation of the tank and closed channels by drawing a current of air through. Instead, therefore, of noticeable odors issuing from the chamber when the cover is raised for the purpose of cleaning the screen, the only effect is to admit air; so that no odor can now emanate from this chamber.

The sewage passes through the screen, and enters the upper of two covered channels by which it is conveyed to the tank, returning by the lower channel, from whence it issues through valved openings on to the beds. This lower channel was formerly open, and delivered the sewage from the screen on to the three beds.

When crude sewage was being treated on these beds the sludge deposited in the bays had to be removed from one or the other bay daily, except Sunday, and the surface of each of the two beds then used had, towards the end of the period, to be cleaned once every three weeks. This required two men to be constantly at work removing the deposit with shovels and barrows. Since the third tank has been in use nothing whatever has been done, either to the bays or to the surface of the beds. Indeed, when the change was made no extra cleaning was done, the sludge being removed in the usual way, but not entirely so, for No. 3 bed was in use for one day under the old method, and the effect can still be noticed on the surface. Had the old treatment been continued there would have been removed by shovels, forks, and barrows, taking October as a standard, 244 tons of drained sludge from the bays, and 131 tons of drier sludge from the surfaces of the beds, each of which would have been cleaned ten times, making a total of 375 tons, or at the rate of 7 tons per 1,000,000 imp. gal.

The top-covered channel conveys the sewage into one of two detritus tanks, which are worked alternately. Each is capable of holding the average flow of sewage during a quarter of an hour, or 1/96 of the total daily quanity. During its passage across the tank the sewage is deprived of the greater part of the inorganic together with some of the heavy organic matters; these deposit and accumulate in the hopper-shaped bottom of the tank. When one tank has been in work for a fortnight the sewage is diverted to the opposite tank, and the accumulated sludge is removed from the full tank by means of a valved opening, which allows it to pass into the sludge manhole, and through it into the ejector, which sends it into the trenches in the land. In this way, every fortnight, from one or other tank, 3,000 imp. gal. of sludge, or about one-half of the total quantity, is removed from the sewage. The sewage, leaving the detritus tanks enters the centre of a transverse channel which conveys it into the sedimentary chambers of the hydrolytic tank.

The hydrolytic tank consists of two parts. The first portion is divided into three compartments by means of light division walls formed by flagstones. Of these compartments the two outer are the sedimentary chambers, and the central the liquefying chamber. Along the bottom of the sedimentary chambers are narrow openings which lead into the liquefying chamber and form the only means of liquid communication between these chambers.

The whole volume of sewage enters the sedimentary chambers behind submerged walls which lead it to a depth of 4 ft. 3 in. below the liquid level in the tank. At the end of the first portion is a level weir which is divided into three parts, one for each chamber; the relative widths of these divisions govern the outflow of sewage from the several chambers, and determine the proportional quantity which flows through each. The two side weirs (sedimentary) have a width of 7 ft. each, or a combined width of 14 ft., and the central weir (liquefying) has a width of 2 ft. The total weir of 16 ft. is therefore apportioned in the ratio of 7 to 1, 87.5 per cent. to the sedimentary chambers, and 12.5 per cent. to the liquefying chamber.

A unit volume of the average flow of sewage entering the sedimentary chambers will traverse them in five hours; of this volume 87.5 per cent. will flow over the sedimentary weirs, and 12.5 per cent. will descend through the openings into the liquefying chamber, causing a like quantity of liquid to overflow the liquefying weir. During its transit through the sedimentary chambers, those matters in suspension in the sewage whose specific gravity approaches to that of the liquid will travel along a practically level plane, while the lighter and the heavier particles will describe upward and downward curves, the length of the curve being proportional to the weight of the particle and the velocity of the flow. The lighter particles will rise to the surface and be retained there by the submerged walls at the end of the chamber. The heavier particles, in falling, will have their curve shortened by the descending volume of liquid which passes out of the bottom of the sedimentary chamber into the liquefying chamber; in other words, the natural downward displacement of the particles will be accelerated by the downward flow of one-eighth of the entire volume of sewage, by means of which the deposit will be carried into the liquefying chamber. In the liquefying chamber the rate of transit is diminished in so much that a unit volume of the entering liquid will take fifteen hours in its passage. This slower rate of flow allows the suspended matter to sink into the lower part of the chamber, and prevents so large a quantity of the suspended matter from being carried out of the tank during periods of agitation caused by the rising gases. It is to be noted that the gaseous ebullition in this portion of the tank is, with almost negligible exceptions, confined to this chamber, and that the evolved gases rise to the surface of the liquid either directly or by being conveyed there by the sloping walls which form its boundaries. These walls, indeed, separate the rising gases in the liquefying chamber from the depositing solids in the sedimentary chambers, and prevent the confusion in operation which would otherwise take place. The part of the chamber below the openings at the bottom of the sedimentary chambers is reserved for the reception of sludge. Its capacity is such that it will hold the sludge contained in forty days' average sewage flow. In active and actual work, however, it holds about 100 days' accumulation of such material. Along its floor, at intervals, are placed openings, controlled by valves, through which sludge is periodically let out of the tank. By these means, once a fortnight, about 3,000 imp. gal. of sludge are removed from the tank, through the sludge manhole, and ejector, to trenches in the land.

The scum, or floating solids, on the surface of the liquid in the sedimentary chambers, and the floated solids in the liquefying chamber are occasionally, when unduly accumulating, raked over into the detritus tank. The sewage flowing over the weirs of the first portion enters a channel which leads to the second portion of the tank. This consists of four hydrolysing chambers, arranged in sequence. The liquid is conducted to the bottom of each chamber by means of nine 6-in. stoneware pipes, where it is delivered below three arches, three of the pipes passing through each arch. The arches support the material, and are constructed of bricks arranged so as to leave for the passage of the sewage 2¼-in. openings between them. The floor under each arch is concave, and forms with the arch a space for the accumulation of sludge. Under each concave floor a line of pipes, having two valved openings, is laid, by means of which the deposit is removed. The material consists of broken flint stone, varying in size from 3 to 6 in. The liquid passes upward through the openings between the bricks, and through the material to the surface, where it overflows a wall, and enters the downward stoneware pipes of the next chamber. After this operation has been repeated in the four chambers the liquid, having taken three hours in its passage, enters the effluent channel which conducts it to the contact beds.

The ventilation of the tank is carried out by means of a fan, driven by a steam engine, which causes a lessened air pressure in the air duct, channels, and tank, and withdraws the gases as they rise to the surface of the liquid. Atmospheric air is admitted at various regulated openings. The chief opening is placed near to the end of the effluent channel, which ensures that the maximum quantity of air shall pass over the surface of the liquid after it has left the tank. This volume is increased in the tank by the air admitted at the several regulated openings. The increased volume passes over the surface of the liquid in the tank, and over that in the effluent channel, to the air duct and fan, from whence it passes to the chimney, where it is discharged into the atmosphere. By these means the air in the tank is, at all times, practically, and relatively, though not absolutely, free from smell. On the other hand, there is no possibility of any of the gases which have been formed in the sewage during its transit in the sewers, or in the rising main, or in the tank, escaping out of any of the openings leading into the screening chamber, tank, or channels. All the evolved gases are diluted with such large volumes of atmospheric air that their effect is scarcely appreciable at the point of discharge.

The sludge removed from the tank, as well as that from the channels of the secondary contact beds, which is now placed into a covered, hopper-shaped opening leading into the sludge manhole, gravitate into an ejector which discharges its contents into trenches in the land.

These trenches are 3 ft. wide, 1 ft. 6 in. deep, and 120 ft. long, a space of 5 ft. being left between each trench for future utilization. Up to the present time 2,400 sq. yd., just under half an acre, have been used in single trenches. The first two intermediate trenches have just been opened, and are ready to receive sludge. At this rate, half an acre will amply suffice for 12 months' sludge disposal. In order to see the character of the sludge after being in the land for a period of six months, one of the earliest filled trenches was opened, and it was found to be 6 in. in thickness and to resemble paste.

In a period of 194, during which 46,560,000 imp. gal. of sewage passed through the tank, it is estimated that 1,038 tons of sludge entered the tank. Of this amount 17.8 tons were taken from the screening chambers, 187.5 tons from the detritus tank, 175 tons from the liquefying chamber, 35.4 tons from the sedimentary chamber (scum), and 2 tons from the hydrolysing beds, a total of 417.7 tons. If the amount of sludge left in the tank were added to that removed from the tank, there would still be over 50 per cent. unaccounted for.

AVERAGE OF 71 SERIES OF SAMPLES, HAMPTON WORKS; IN PARTS PER 100,000.

	Crude sewage.	Hydrolytic tanks.	Contact beds.
Suspended solids	43.8	1.4	.00
Solids in solution	117.7	107.7	92.9
Chlorine	21.6	18.0	17.0
Ammoniacal nitrogen	7.98	8.56	1.19
Albuminoid nitrogen	1.51	0.60	0.13
Nitrous nitrogen	00	00	0.02
Nitric nitrogen	00	00	2.55
Oxyen absorbed	9.0	6.4	0.83

Since the tank has been in use the effect on the beds has been very marked. Apart from the differences associated with the sludge accumulations which have already been mentioned, the following may be noted:

(1) The presence of worms in primary beds.

(2) The appearance of nitrates in the secondary beds effluent, and of a green growth in the channel leading from those beds.

(3) The increasing amount of nitrates, as well as the diminishing quantity of nitrites in the final effluent, indicating a higher degree of purification.

Large Vertical Engines.

A pair of vertical, inverted slow-speed engines of the four-cylinder, triple-expansion type have recently been installed in the central station belonging to the City of Manchester, England, which are stated to be the largest of their kind in Europe. According to "Engineering," the high-speed cylinder is 37 in. in diameter, the intermediate cylinder 59 in. and the two low-pressure cylinders each 72 in., with 5-ft. stroke. Each engine can work condensing or non-condensing without alteration of the setting of the valves. The engines are built under a guaranty of a mechanical efficiency of 91 per cent., a steam consumption of 11 lb. per indicated horse-power, with steam superheated to 500° Fahr. and 27-in. vacuum, and 18 lb. consumption when running non-condensing. When condensing each engine will indicate 6,000 h.-p. at full load and 6,500 i.h.p. for two hours, and when non-condensing 5,000 i.h.p., with a steam pressure of 190 lb. at the stop valve, 75 r.p.m., and superheat to 500° Fahr.

The cylinders are fitted with liners, leaving a 1-in. space between them and the walls, which is used for a steam jacket, and the cylinder ends are also steam-jacketed. All are lagged with asbestos to a total depth of 5 in., with an air space of 1½ in. in the center. Corliss valves with Dobson-Corliss trip gear are used, the cut-off being regulated by a main governor of the Whitehead type; this is set to prevent a speed variation of more than 1½ per cent. from normal between no load and full load. The fly-wheel, forming the revolving field of the alternator, weighs 75½ tons without and 112 tons with the magnets in place. The steel shaft weighs 15½ tons. Forced lubrication is employed, the bed-plates forming oil tanks and the oil pumps being driven by the main engine. Electric barring gear is provided.

Checking Water Waste in Somerville.

The last Massachusetts legislature changed the provisions of the law under which water is furnished by the Metropolitan Water and Sewerage Board to cities and towns, so that payment is based one-third on the tax valuation and two-thirds on the consumption, instead of wholly on the tax valuation, as before. This has led to an increased use of meters, and, in the case of Somerville, to the detection of many cases of waste.

As is natural in a transition period of this kind, when the rate-payers are changing from a system which has given them no concern in regard to the use and waste of water to one which requires them to adopt reasonable precautions against water waste, blame and abuse are at times placed upon the meter, instead of upon the defective plumbing, which is really at the bottom of the trouble. It has been the policy of the Somerville water department, upon receipt of a complaint of an unusually large metered water bill, to arrange with the rate-payer to have the meter tested, and the result is uniformly that, if the meter is found to register at all outside the allowed limit of accuracy, it is in favor of the consumer, and not of the city. It is well for those having water meters to understand that a large quantity of water can be wasted through a small orifice, and that defective faucets and water-closet ball-cocks are the most prolific sources of this trouble. Another great cause of waste of water is letting the water run during the cold weather to prevent its freezing; this has been a simpler and cheaper method for the landlord to follow than to properly protect the pipes and fixtures, but it is believed that the installation of a meter on such premises will lead to better conditions in the house plumbing and a more rational method of preventing this trouble than by the waste of a valuable and costly commodity.

A hole one-thirty-second of an inch in diameter is so small that an ordinary pin will completely fill it, yet in three months it will waste a quantity of water, if running constantly, that under the Somerville rate costs $3.57.

Steel Cross Ties are being rolled by the Carnegie Steel Co., Pittsburg, Pa., as a substitute for wooden ties. Their cross section somewhat resembles that of an I-beam. It has a top flange 4½-in. wide, a bottom flange 8-in. wide, a depth of 5½-in. and is 8 ft. 6 in. long. Each tie weighs 167.4 lb., exclusive of the 6 lb. of fastenings by which the rail is attached to it. These fastenings are rolled-steel clips, fitting accurately the lower flange of the rail and attached by ¾-in. bolts. The bevel of the clips is the same as the bevel of the flange and the rail, and they are punched so the shoulder of the clip gives proper and positive rail alignment. Where automatic block signals are in use the rails are insulated from the ties by wooden shims between them and the clips, fiber bushing around the bolts and fiber washers under the nuts. These ties have been sufficiently tested in service for two years to demonstrate their efficiency and they are now being laid by several large railroads.

Paper and Paint for Steelwork.

The use of paraffine paper and paint as a protective covering for steelwork has been tried for some time at the Jersey City terminal of the Pennsylvania R. R., under the direction of Mr. Louis H. Barker. At the recent meeting of the American Society for Testing Materials he gave some very interesting notes concerning the steps leading up to this innovation in painting. About eleven years ago an experimental investigation was begun with numerous well-known and established iron paint preservatives, in order to ascertain by actual exposure tests the best one to resist the destructive action on steel structures of sulphurous gases in the form of smoke combined with the moisture of steam, and since that time fifty or more paints and combinations have been tried. Among them were many kinds of asphaltum, rubber, graphite, carbon lead and iron paints, and though the results showed varying degrees of resistance, it is remarkable that even with three coats of paint not one was found that did not show rust in less than a year. Of course, it is to be understood that the exposures were made so as to subject the test bars to the severest action possible in order to obtain the quickest results.

Experimental Bars Exposed Eight Months.

In making the first series of tests new steel plates 10 in. square were used. As, however, the adverse conditions the company was trying to overcome related to rusty steel, which is more difficult to preserve than new steel, rusty plates were substituted in all tests thereafter.. And to still further endeavor to meet the existing conditions new plates were hung up and exposed to the smoke fumes until they became covered with sulphur scale, the thought being that an oxide scale due to atmospheric exposure might give different results. This scale or rust formation on these new plates apparently varied not only in amount, but also in the time of its formation, supposedly due to different chemical composition. As this might again give some variations in the experimental results, in order that all paints should be on as like footing as possible, angle bars 11 ft. long were made use of and as before hung in the smoke until rusted, then cleaned with wire brushes, each foot of the bar painted with a different paint and again hung up. The results, however, continued to be unsatisfactory.

In examinations of the test bars from time to time it was seen that upon many of them the paint was intact, but with protruding points which, upon being pricked, were found to be small rust formations pushing up the paint from behind, clearly indicating that it was not the failure of the paints but the rust action on the inner surface that caused the damage. As no rust can form without the presence of moisture, and as all paints are pervious to moisture (as Dr. Dudley's careful investigations of the subject have proved) thus led to the conclusion that it would be necessary in some way to tightly seal the surface. Many kinds of materials for doing this were tried, with as many different results, until three years ago it was decided that a cheap paraffine paper answered the purpose best of all and since that time all experiment has been along that line. A few test bars were exhibited at the convention to indicate the results and an illustration of four of them is given herewith. The lower half of each bar is protected by paper and the upper half by three coats of paint. Besides the experimental bars referred to, the paper covering has been tried in a small practical way against smoke action, and after two years and three months exposure an examination of very recent date shows the outer paint, the paper and the first or adhesive coat all intact and in many places where paper was removed for examination the adhesive coat was not yet dry and the surface of steel the same as when painted.

With such satisfactory results from this paper-process in the smoke tests, it was concluded to make a large scale application and severe test on a large number of eye beams supporting a floor over and within a few feet of salt water and upon which the rust was due not to smoke but to the almost continuous dampness and presence of sewer gases. This was done over a year ago and up to this time indication of damage of no kind is apparent.

The mode of application of the paper is as follows: After the rust is carefully cleaned off by means of stiff wire brushes, a certain kind of tacky paint is applied, the paper then covered over and tightly pressed upon the painted surface, the joints of the paper slightly lapping. As soon as the paper is in place, it is ready for the outside coat of paint. It will be observed that by this process, the first coat of paint, the paper and the coat of paint over the paper can be applied with one scaffolding, thereby greatly reducing the cost, especially in high and dangerous places.

These experiments, extending over only three years, are of too short a duration to determine the value of paper as a protection for iron and steel, but Mr. Barker believes that they prove the fact, at least in the case of smoke and gases, that the action begins from behind the paint and not from in front by the disintegration of the paint.

Stop-Valve Boxes of reinforced concrete are being used on the St. Louis water-works. According to Commissioner Ben. C. Adkins, three men can assemble the parts of one of these boxes, which are made in the municipal testing laboratory, with very little more labor than is required in setting a wood box. The cost last year was 70 cents for cement, 25 cents for sand, 30 cents for stone, $3.68 for expanded metal and $1.20 for labor; a total of $6.13. The proportions of the concrete were 1:2:4.

Details of the Wanamaker Power House, Philadelphia.—I.

The Wanamaker department store building at 15th and Chestnut streets, Philadelphia, is a steel frame structure twelve stories high, which contains about 40 acres of floor space, and will be one of the largest stores ever built. It will be equipped with steam heat, electric light, pneumatic service, freight and passenger elevators, ventilating and refrigerating apparatus, etc., all operated by a special power and mechanical plant which, to save room in the store building and isolate it from vibrations and other features of power development, will be installed in a separate power house in another block, about 170 ft. from the store building, with which it will communicate by a tunnel in which steam, air, water and electric mains will be located. The store building is being erected in sections, of which the first is nearly completed, and the power house has been erected so as to furnish power for the first part of the main building before the other parts are completed.

The 66x90-ft. power house, 165 ft. high, is of steel cage construction, and is remarkable for the number of heavy girders and for the unusual weight of structural steel employed in a building of its moderate dimensions. The building is five stories in height and the 62½-ft. lower story is divided by a longitudinal wall into an engine room and a pump room. Over the pump room there are two mezzanine floors below the second, or main floor, which is called the boiler auxiliary floor. Next follow the boiler room floor, the coal storage floor, the refrigerator room floor and the roof, making in all seven tiers of beams.

The building will be equipped with eight 663-h.p. Babcock & Wilcox water tube boilers, four 500-k.w. and six 175-k.w. direct-connected electric generators manufactured by the Crocker-Wheeler Co.

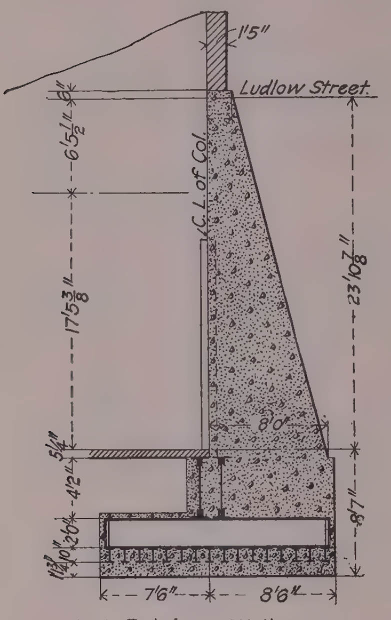
Five vertical cross-compound non-condensing engines, direct-connected to the generators mentioned, are to be installed by the Southwark Machinery & Foundry Co., of Philadelphia. Steam pressure at engines is 140 lbs. per sq. in.; speed of two large engines (1,000 kw.) is 115 r.p.m.; speed of three small engines (350 k.w.) is 150 r.p.m. The switchboard is to be installed and all wiring in power house is done by J. Buchanan & Sons, Philadelphia. Main switchboard is of marble and contains all necessary generator, totalizing and distributing panels.

Four duplex boiler feed pumps, each having a capacity of 69,000 lb. of water per hour, are to be installed, and four feed water heaters, each capable of heating 69,000 lb. of water per hour from 45° to 210° Fahr. Also two return pumps, of the centrifugal type, submerged in condensation tank, each of a capacity of 200 gal. per minute. Two bilge pumps, each of 100 gal. per minute capacity, will deliver all drainage from the mechanical plant to sewer. The house tanks in the main store will be supplied by three triplex pumps, running at 50 r. p.m. and having capacity of 10,000 gal. per hour each. Two centrifugal pumps of 220 gal. per minute capacity will supply water to the boiler feed pump, and two similar pumps will furnish artesian water to the refrigerating plant. All of the above pumps are to be furnished by the International Steam Pump Works, and operated by Crocker-Wheeler motors, W. K. Mitchell & Co., of Philadelphia, being the general contractors for this work.

The pumping plant to serve all of the elevators in the main store and power house will consist of three flywheel pumps operated by steam and one triplex electrically driven pump, together with the necessary tanks, auxiliaries, air compressors, etc. There will be 52 passenger elevators 10 freight elevators and 7 sidewalk lifts operated from this plant, which is being installed by the Standard Plunger Elevator Company.

The foundations of the building are on gravel and sand at a maximum depth of about 39½ ft. below the curb and are several feet below the original footings of two tall adjacent buildings, which were underpinned before the new foundations were commenced. The power house framework has 21 main columns, three of which are located in a longitudinal row 5 ft. from the center line of the building, and all the rest are close to the outer walls. In order to support the wall columns as near as possible to the building lines they are all seated on a system of longitudinal and transverse cantilever girders, which form a skeleton framework covering the whole area of the building. At the ends of the building there are three short girders, G12, which span the distances between adjacent small footings, and are supported on their centers, beyond which they project to carry single columns on short cantilever arms.

All the other transverse girders, three lines,



Vault Retaining Wall

THE ENGINEERING RECORD.

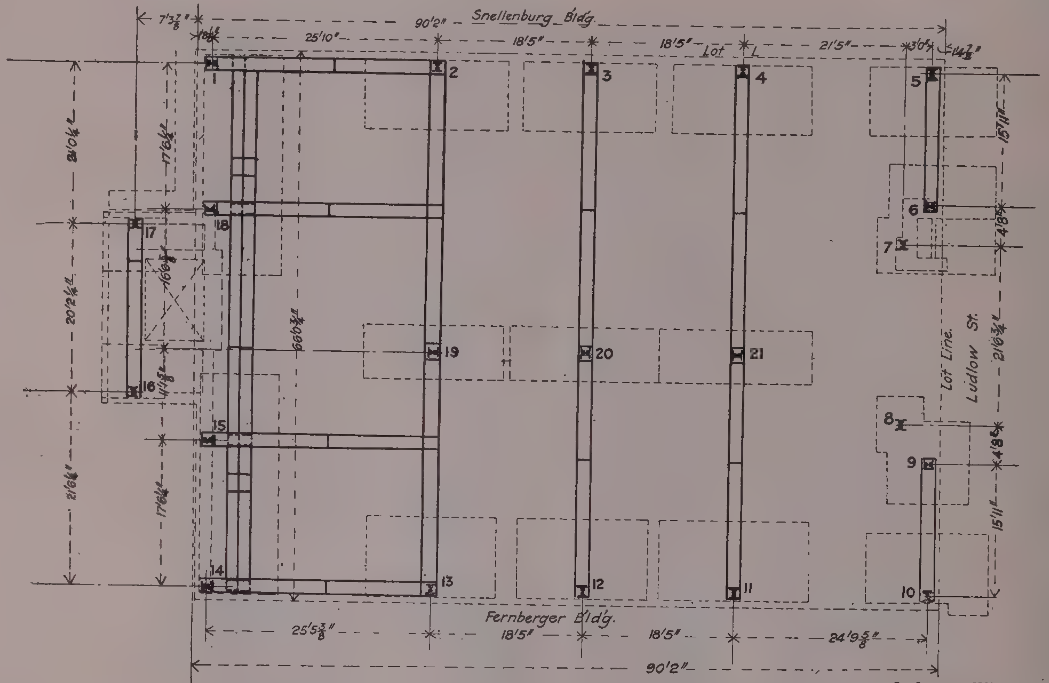
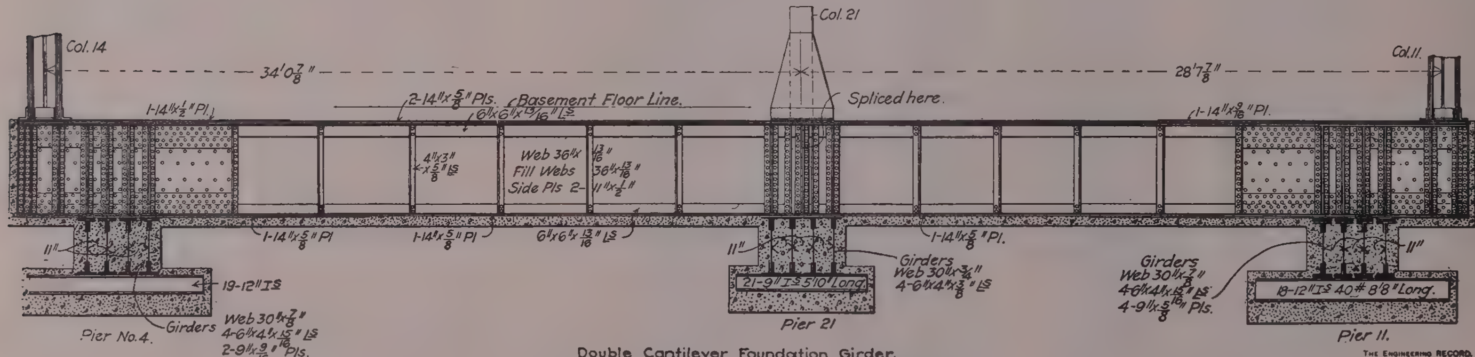


Diagram of Footings and Foundation Girders.

THE ENGINEERING RECORD



Double Cantilever Foundation Girder.

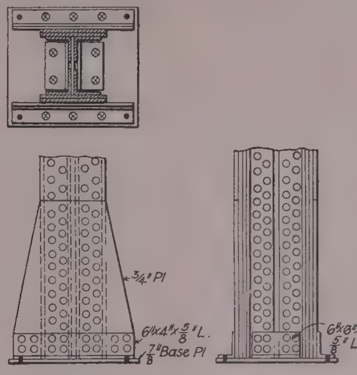
THE ENGINEERING RECORD.

Foundation Cantilever Girders and Basement Walls.

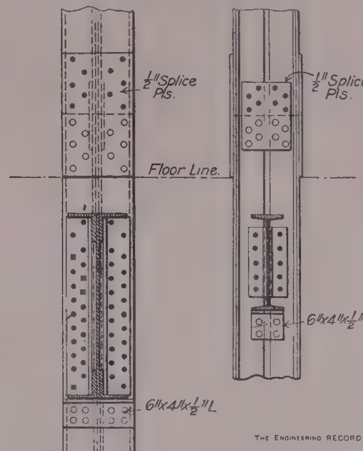
are double cantilevers, made continuous across the full width of the building, and are supported at both ends and in the middle and carry one column in the middle and one at each cantilever end, which are seated on their top flanges. Two of them are also loaded by four longitudinal single-cantilever girders carrying end wall columns. Girders 10 and 11 are typical of the transverse girders and are of simple plate girder construction, with T-shape flanges, and have the web heavily reinforced with cover plates and pairs of vertical angles at the ends to resist the concentrated loads and reactions there.

The three full length parts of each girder were shipped separately from the shop and after erection were connected by transverse vertical diaphragms. The transverse distribution girders on which they are supported, are from 18 to 19 ft. long at the different footings where they are seated on single tiers of I-beam grillages in concrete beds proportioned to load the soil with a uniform pressure of 12,000 lb. per sq. ft. After the cantilever and distributing girders were assembled they were entirely enclosed and the interstices between their webs were filled with concrete with a minimum thickness of 4 in., the upper surface of the concrete forming the basement floor and being supported between the girders on leveled back fill. The short cantilever girders, 12, at the end of the building, are twin girders, with their center line in the inside vertical face of the heavy concrete retaining wall, which is carried on their footing grillage, as indicated in the cross section. The construction at the opposite end of the building is similar, but the wall is lighter and the girders and footing are smaller.

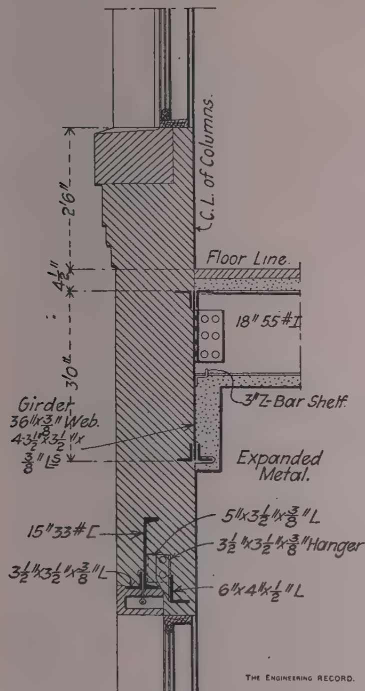
Between columns 7 and 10 a chamber 15 ft. high is excavated under the street, beyond the retaining wall, for the coal receiving and conveying plant and for the terminal of the tunnel to the store building. The outer wall of this chamber has a framework of vertical I-beams 4 ft. apart riveted to top and bottom horizontal channels and having concrete arches sprung between their channels. The top of this wall supports one end of a 54-in. plate girder, which is connected at the opposite end to column 8. This girder carries one end of each of two other girders at right angles to it which are supported at their opposite ends on the retaining wall and carry the roof beams of the chamber and the retaining wall for the upper story of the vault. The roof of the tunnel and chamber is of concrete arches which wholly enclose the I-beams. The girders and all other



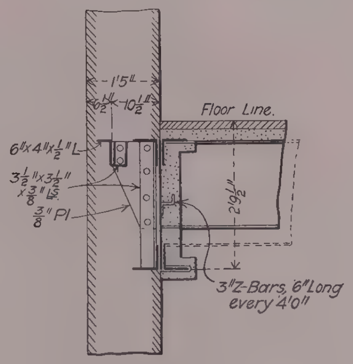
Regular Column Base



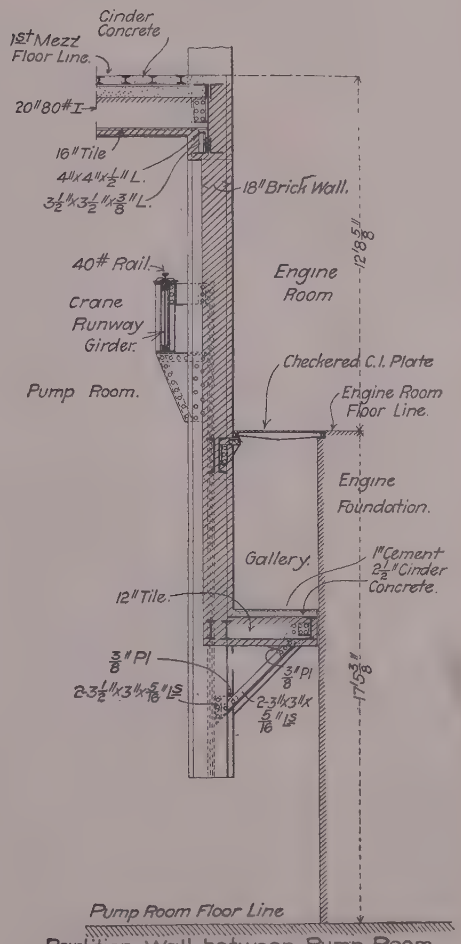
Typical Girder and Beam Connections.



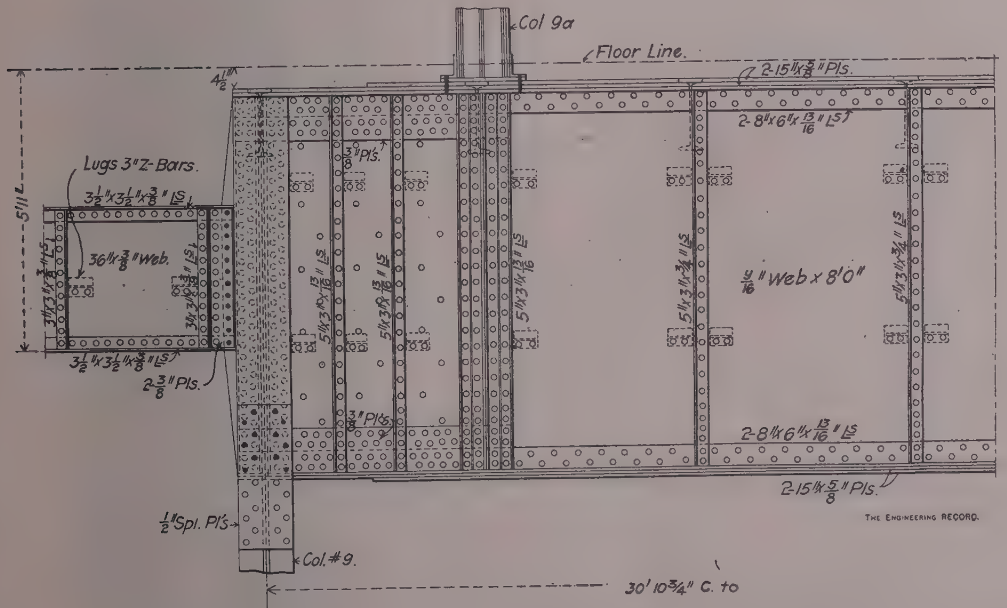
Spandrel Section of End Wall
Boiler Auxiliary Floor.



Spandrel Section of Side Wall.
Boiler Auxiliary Floor.



Partition Wall between Pump Room and Engine Room.



Girder 6-9 in Boiler Auxiliary Floor. For Floor Load only.

Column, Girder and Principal Wall and Column Details.

parts of the steel framework are also enclosed in concrete and the roofs and walls are entirely enclosed by waterproofing protected by a single course of bricks.

The engine room and the pump room are separated by a brick partition wall enclosing the interior columns, but which does not extend down to the bottom of the pump room. It is carried on I-beams connected to the columns at a clear height of about 8 ft. above the pump room floor, thus leaving the lower part of the building unobstructed, except by the three columns and by the large masonry piers for the engine foundations, which occupy a large part of the floor on the engine room side of the partition. The main floor of the engine room is carried on the tops of these piers, about 17½ ft. above the pump room floor. The partition wall, therefore, extends several feet below the floor and serves as one side of a conduit in which the electric cables are carried. The tile arch floor of this conduit is sprung between the I-beams which carry the partition wall and a parallel I-beam bracketed out from the columns and supported intermediately on light vertical columns.

The pump room ceiling is about 28 ft. in the clear above its floor, and the partition wall terminates at the first mezzanine floor. Longitudinal girders 30-in. deep are bracketed out from the columns on both sides of the pump room and form a runway extending through a little more than three panels of the building for a traveling crane of 25 ft. 8 in. span and 10 tons capacity. The girders are seated on solid-web, double knee brace brackets riveted across the faces of the columns and are stayed just below their top flanges by horizontal tie plates to the columns. At the end of the building the runway girders have short vertical posts supporting them from the top flanges of the wall girders at a lower level, and are braced to it by transverse inclined struts. At the opposite end of the runway they cantilever 5 ft. beyond the columns.

The upper floors, roof, coal bin and walls are entirely supported by 18 columns built into the outer walls and three interior columns located in a longitudinal row parallel to the axis of the building. They all have I-shape cross sections made with plates and angles, and are built in four sections, having a total length of nearly 164 ft. All of the upper sections are one story high and have a uniform cross section made with a 13x½-in. web plate and four 4x3x⅜-in. flange angles, or with 17x½-in. web plate and four 5x3x½x⅜-in. flange angles. Most of the other sections are two stories high, with splices a few inches above the floor lines. The columns in the engine room walls are made in single sections, 66 ft. 9 in. long, one of them is among the heaviest in the building and is built up of one 13x⅞-in. web plate, four 6x8x⅞-in. flange angles and three 18x¾-in. and four 18x⅞-in. flange cover plates. Some of the other columns have sections made with two 17x⅞-in. web plates, four 6x8x1-16-in. angles and eight 15x⅞-in. flange cover plates. The splices are made with single flange cover plates and double web cover plates. Beams and girders are seated on short horizontal angles, provided chiefly for convenience in erection, and are connected to their webs and flanges by field rivets in two or four rows through the flanges of vertical end angles shop riveted to the beam and girder webs. The base plates are extended beyond the column faces and their projections are stiffened by gusset plates on the column flanges.

The mezzanine floors above the pump room are chiefly made with hollow tile flat arches, 16 in. thick and about 4½ ft. span, supported on 15-in. I-beams of 25 to 27 ft. span. In the first mezzanine floor the 15-in. beams are carried on 15-in. and 18-in. I-beams riveted to the columns, and are arranged both longitudinally and transversely. In several panels between the 15-in. beams there are rectangular openings for cables which have vertical plates like curbs with top and bottom flange angles around the sides. The spaces between these curbs and the floor beams are filled solid with concrete. At one end of this floor the full width for a length of 17 ft. is spanned by 20-in., 80-lb. I-beams 2 ft. 3 in. apart, which carry on their top flanges 4 in., 7½-lb. I-beams 18½ ft. long and 12-in. apart on centers, forming a very strong platform covered by a concrete floor slab supporting heavy tanks.

The platform has a capacity of 600 lb. per sq. ft. and the 20-in. I beams are web-connected to plate girders in the planes of the walls. At this level the brick walls on two sides of the pump room are carried on single I-beams bracketed out 11½-in. from the centers of the columns. On the other sides of the building the outer walls are self-sustaining at this level, but at the level of the second mezzanine floor they are all carried on 12-in. and 18-in. I-beams, the former being used for spans of 17 to 20 ft. and the latter for spans of about 25 ft. The second mezzanine floor is like the first except that the heavy platform at one end and the cable openings in the intermediate panels are omitted.

In the engine room a traveling electric girder crane of 30½ ft. span and 20,000 lb. capacity, made by Alfred Box & Co., Philadelphia, moves from end to end of the building 11 ft. above the mezzanine floor on plate girder runways 30-in. deep seated on double-web knee brace brackets riveted to the faces of the columns. The boiler auxiliary floor extends across the full width of the building, which is not subdivided by any partition wall above this level. The floor is divided into three full width panels by two transverse plate girders, each of them with a 7-16-in. web., and four 6x6-in. flange angles reaching from column 2 to 13 and from column 4 to 11. These girders support the ends of the 18-in. and 20-in. longitudinal I-beams from 4 to 5½ ft. apart in the end panels. In the center panel of the floor there are 20-in. transverse I-beams from 3½ to 4½ ft. apart supported by 24-in and 30-in. plate girders on the intermediate and wall columns. The floor has a capacity of 800 lb. per sq. ft., and is made with concrete slabs 5½-in. thick reinforced by ⅜-in. suspension bars, 3 in. apart, hooked over the top flanges of the floorbeams crossed by ¼-in. rods, 9 in. apart, and covered with tiles, 2-in. thick. The walls at this level are carried partly on beams, channels and angles, bracketed out from the faces of the columns, and partly on plate girders where the floor loads are heaviest. All of the girders are fireproofed by enclosing them in solid masses of concrete, which for the deeper ones, is locked and supported by horizontal Z-bars riveted to the girder webs, as indicated in the cross section details which show the spandrel construction.

At one end of the building the distance between the two intermediate wall columns is 9 ft. 4 in. less above this level than it is below it; therefore a very heavy plate girder, as shown in the detail, is seated on the lower columns to carry the upper ones. It is 8 ft. deep, nearly 31 ft. long over all and weighs about 25,000 lb. Between the upper and lower columns the ends of the web are reinforced by cover plates to a thickness of 15-16-in., and are stiffened by several pairs of vertical angles, which, on the center lines of the columns, are arranged to practically continue the column sections across the girder web. At the ends of the girder, pairs of reversed angles are riveted to the outstanding flanges of the stiffeners and have cover plates parallel with the girder web, making that portion of the horizontal cross section of the girder like a double H, and affording at the lower end of the stiffener a connection for side splice plates like jaws projecting above the column top.

D. H. Burnham & Co., Chicago, are the architects, Mr. J. G. Giaver structural engineer, The Thompson-Starret Co., New York, general contractor, and the American Bridge Co. sub-contractor for the structural steel.

(To be Continued.)

Reinforced Concrete Roundhouse, Toronto.

The Grand Trunk Ry. has recently constructed at Toronto, Ont., a reinforced concrete roundhouse that has attracted considerable attention from railroad officials. It has thirty stalls, each measuring 13 ft. in width at the inner circle, and 26 ft. at the outer circle. Each stall is 82 ft. long, and divided into three sections, and carried on four columns. The entire structure is built of concrete, reinforced with the Kahn trussed bars.

The interior columns are 14 in. square, and contain each four ½ x 1½ in. trussed bars. The diagonals of these steel members are bent horizontal in order to obtain the effect of hooping. Angle guards were placed in all corners in order to prevent chipping. The columns in the outer circle are T-shaped, forming a pilaster on the outside, and at the same time supplying recesses for keying the curtain walls between columns. The joints at these points allow for expansion and contraction.

In designing the columns in the interior circle, it was feared that locomotives striking the outside doors would break the concrete columns which carried the door. For this reason these were made of three channels filled with concrete. This construction was decided upon because such a column would not break, but would merely shift off its foundation if struck with a locomotive. Doors were fastened directly to these channels. On the side not containing a channel were placed ½ x 1½ in. trussed bars as a reinforcement.

Radial lines of reinforced concrete girders were placed between columns at a height of about 20 ft. 5 in. from the top at the outer circle, and 24 ft. 2 in. at the inner circle. Seven longitudinal rows of reinforced concrete beams were spanned between the girders and columns. Both beams and girders were reinforced with Kahn trussed bars in the bottom, and over the supports they were invariably made continuous with inverted bars. Each beam contains in the bottom at least two bars full length and one bar about two-thirds the length at the bottom in the center and raised at the ends. Between the beams and girders is a 4-in. reinforced concrete slab, made continuous over the entire area.

Especial attention was paid toward obtaining an absolute monolithic character in the entire structure, so that if an excessive load were placed upon any one portion the same would be distributed over the adjoining panels. Anchors for carrying steampipes and controlling individual smokestacks over locomotives were placed in the concrete while the same was green.

THE INDEPENDENT MOTOR DRIVE has been adopted for every tool in the addition to the John Simmons Co. pipe-fitting shops in New York. High-speed steel is used extensively in this plant and the motor equipment has been designed to develop the full capacity of the tools with such steel. Although in doing this the total horsepower capacity of the motors is large, the current-generating equipment is of smaller capacity than would be needed for shaft and belt transmission. Crocker-Wheeler motors are employed and in attaching them care has been taken not to change the original state of the tool, which can be readily changed back to the belt-driven form.

The Fire Resistance of Different Concretes.

The Committee on Cement for Building Construction of the National Fire Protection Association has recently conducted a series of tests at the Underwriters' Laboratories to determine the relative fire resistance of concrete composed of various materials in different proportions, so that when the requisite superintendence is available to enforce good workmanship, a building of high fire resistance may be obtained. These tests were based on the theory that concrete construction depends for its fire resistance chiefly, if not wholly, not on the style of its reinforcement, but on two essential qualities of the concrete itself, viz.: Its ability to withstand cracking or disintegration which should reduce its own strength or expose the steel it was designed to protect and its heat insulating value as a steel protection even when not broken or disintegrated.

The samples for test were in the form of beams 8 x 11¼-in. x 6-ft., each containing three plain round steel rods, 6½-ft. long, and projecting about 3 in. at each end and located 1, 2 and 3-in. respectively from the bottom of the beam. Holes were left from about the middle of each rod to the top surface of the beam for the purpose of inserting thermometers for measuring the degree of heat transmitted to the various rods. The composition of the beams, by volume, is given in the accompanying table:

The aggregates contained the following percentages of voids: Granite, 40 per cent.; gravel, 36 per cent.; limestone, 42 per cent., which indicates that the samples containing the medium and larger quantities of cement were nearest the ideal composition, while the leaner ones were not quite strong enough.

Proportions of Portland Cement Concrete Beams and Results of Tests after 45-48 Days.

No.	Proportions.	Aggregate.	Maximum. deflection. in.	Longitudinal expansion Lower rod. in.	Middle rod. in.	Upper rod. in.	Beam. in.
1	1:2:3	Coarse screened gravel	1/8	9/16	5/16	5/16	7/16
2	1:2½:5	Coarse screened gravel.	1/8	9/16	5/16	5/16	5/8
3	1:3½:7.	Coarse screened gravel.	3/16	9/16	5/16	1/4	1/2
4	1:2:3	Limestone not over 1¼ in.	1/4	9/16	5/16	5/16	1/2
5	1:2½:5	Limestone not over 1¼ in.	3/16	9/16	3/8	5/16	1/2
6	1:3½:7	Limestone not over 1¼ in.	3/16	9/16	5/16	5/16	1/2
7	1:2:3	Granite not over 1¼ in.	1/8	9/16	5/16	5/16	1/2
8	1:2½:5	Granite not over 1¼ in.	1/16	11/16	3/8	5/16	11/16
9	1:3½:7	Granite not over 1¼ in.	1/4	11/16	9/16	5/16	13/16
10	1:2:5	Cinders.	3/16	5/8	5/16	1/4	5/16
11	1:2:6	Cinders.	1/4	7/16	5/16	1/4	1/4

These aggregates were selected as representing such variety of materials commonly used as was available in Chicago. Sand was of considerable range in size and fairly sharp. The cement was the Wolverine brand, made by the Michigan Portland Cement Co., of Detroit. Samples were taken from each bag and mixed together, and tested by Prof. R. Burnham of Armour Institute, who reports the following results: Amount passing No. 100 sieve, 94 per cent.; amount passing No. 200 sieve, 86 per cent.; specific gravity, 3.10 per cent.; tensile strength after 24 hours in moist air, 206.3 lb.; after 24 hours in moist air and six days in water, 480.7 lb. The tensile tests were made on neat cement and the figure given is the average of ten tests. All the materials were purchased in the open market and not intended to represent any special system of construction.

The samples were all made on April 1st by experienced workmen, under the direction of Messrs. R. & S. Sollitt, of Chicago, a prominent firm engaged in that sort of work as contractors. In mixing, the sand and cement were laid down first and turned over with shovels four times, then the stone and water added and the whole shoveled over four or five times more, enough water being added to make a medium wet mixture. The beams were taken out of the molds and left, both before and after removal from the forms, in the shaded corner of an open yard, where they were occasionally wet by rain. At the age of 45 to 48 days the beams were tested two at a time while laid so as to form the roof of a low brick furnace 2½-ft. wide, 4 ft. long, and 2½-ft. deep in the clear. Ventilating holes 3 x 8-in. were left at each side of each beam on both ends of the furnace. The furnace was heated by two 3-in. Bunsen burners, using natural gas, over which was laid an open brick lattice work to distribute the heat evenly through the chamber.

A Le Chatelier pyrometer was inserted through the top of the furnace so that its point was between the two samples and about an inch below their lower surface, and three standard mercury thermometers reading up to 650° F. were inserted in each beam with their bulbs resting on the steel rods. No attempt was made to load the beams.

Each sample was kept in this furnace three hours, while the temperature as indicated by the pyrometer gradually rose to about 1,900° to 2,000° F. They were then taken out and allowed to cool in the open air without the application of water. While there is some difference in the speed with which temperature rose, there is no indication that the difference in the materials composing the concrete was an inportant factor in the insulating quality of the product, except in the case of the two cinder samples, in both of which the rise in temperature of the rods was quite noticeably slower than in any other sample. There also is a clear indication that the richer mixtures of all materials were slower conductors.

The time required to heat up the rods in all samples which had only one inch of concrete covering, as compared with those covered 2 and 3 in. deep, is the prominent feature of the temperature records and indicates clearly that reinforcing steel members covered to that depth only reached a temperature of 770° F., where their strength is impaired to the extent of 25 per cent. very early, well within 1½ hours, or averaging 59 minutes for the 11 samples. Those with 2-in. covering attained the same temperature in an average of 2 hours and 20 minutes, and those protected by 3-in. of material, in 2½ hours, on an average.

In none of the samples was there any sign of breaking or chipping off of the concrete during the fire, but after being removed it was found that the material had lost practically all its strength to a depth of about 4 in. from the sides and bottom and that it had softened perceptibly clear to the top. The cement and most of the stone, including both limestone, gravel and granite, seem to have been calcined quite thoroughly at the surface and in a diminishing degree up to about 4-in. depth. There is no very wide difference in this respect between the various samples, though the beams having the greatest proportion of cement seem to be somewhat more solid than the others.

In all cases, a little water and steam appeared during the test at a few cracks running across the top of the beams, this being most noticeable in the richest mixtures and appearing chiefly during the time the thermometers indicated 212° F., as they did for periods of 20 to 40 minutes.

The accompanying table shows the deflection of each beam as varying from 1-16 to ¼-in., and the expansion of the beams and the individual rods as from ¼ to 11-16-in.

The tests were planned to give a severe but not excessive trial as to duration and temperature of furnace, but the committee feel that they were distinctly favorable to the materials in that no load was applied and that they were not wet by hose streams while hot—with the limited time and facilities at hand it was not feasible to arrange these conditions—but it is quite probable that with added strains, imposed by loading or wetting, less favorable results might have been obtained.

The committee suggested the following general principles on which such work should be planned:

First—The work should invariably be designed and its entire erection supervised personally by engineers of skill and experience in this particular line.

Second—Concrete for fireproof construction should be composed of high-grade tested Portland cement, clean sand, and broken stone, gravel, slag or cinders, so proportioned that the cement will completely fill the voids in the sand and the mortar thus formed will a little more than fill the voids in the aggregate.

Third—The materials should be well mixed by machine with enough water to make the mass distinctly a "wet mixture," and should be tamped down so that no voids are left.

Fourth—All steel members of whatever style should be imbedded at least 2 in. in the concrete, and in the case of important load-carrying members, 3 in.

The committee was not yet able to make any tests of fire resistance of these blocks, but would venture the opinion that when made in the proportions of one to four or five, they would not be found to differ widely from other forms of concrete as to heat conductivity or tendency to disintegration, but the fact that they are hollow and that the side of the shell next the fire would heat up more rapidly than the other sides, would allow an equal expansion which might result in the hottest side breaking away from the others, in exactly the same manner as hollow tile breaks. Whether this theory is correct or not, and if so, at what temperatures and at what time in the fire serious breaking would occur, should be the subject of investigation. Another important question is, what effect fire would have on the mortar joints between these blocks. It is well known that new concrete does not bond well with old, and whether or not common cement mortar makes a sufficiently strong bond between two pieces of concrete which have been allowed to set for some weeks, is a matter of doubt.

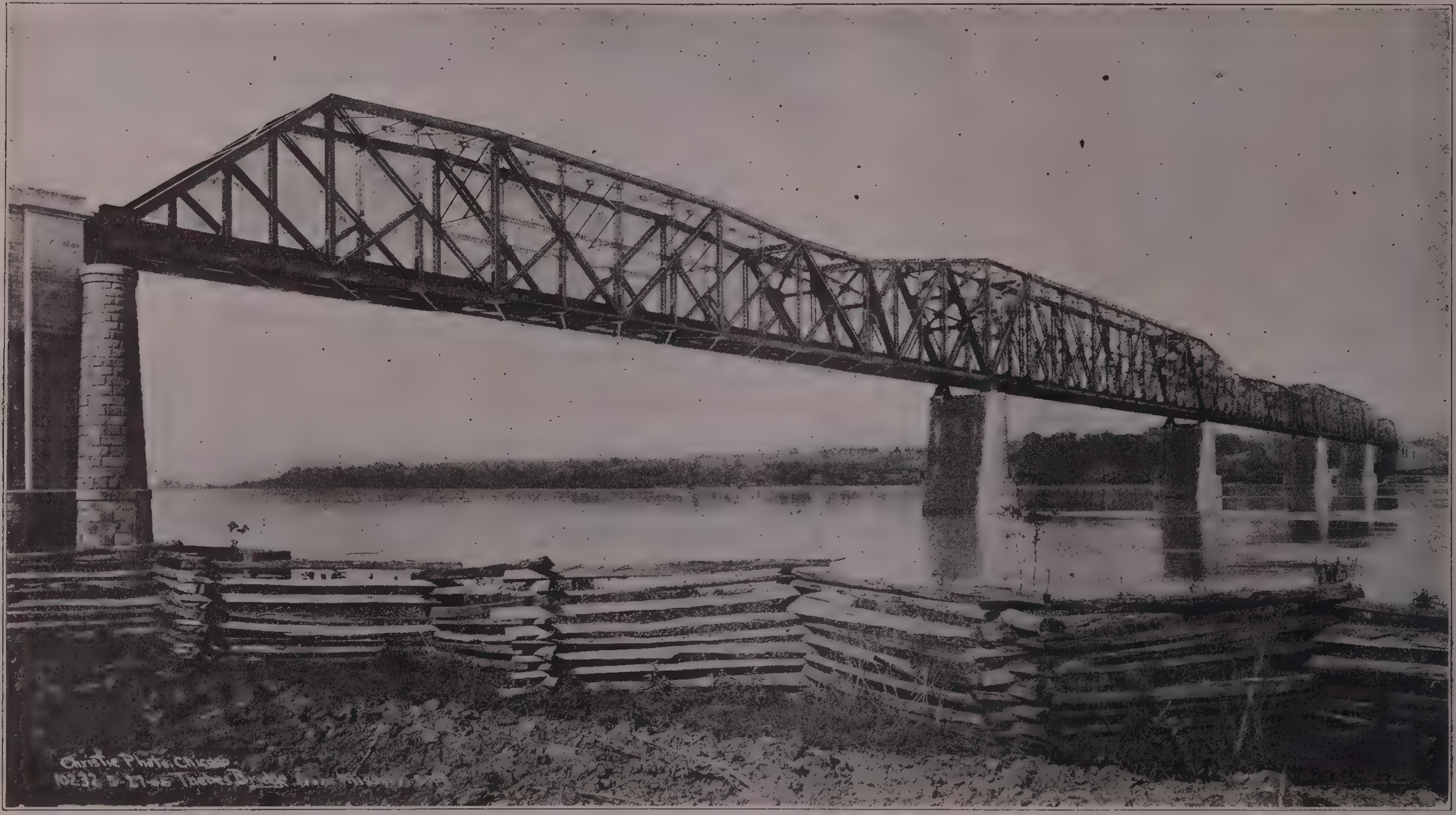
It may reasonably be expected that within a few years the commercial development of the cement block industry will result in an increasing uniformity of practice, but it would seem that while this development is going on, investigation by this or similar bodies, tending to demonstrate the methods and materials necessary to produce a block of high fire resistance, would be in order.

The diversity of present practice is so wide that it is almost impossible to rate the fire resistance of concrete blocks as a whole as now being produced. It is probably safe to say that blocks made as the machine builders advise are practically as good as ordinary brick for small buildings where the heat in case of fire would not be very high or of great duration, but many of those now in use have been so cheapened by use of too little cement or improper drying that their value in strength, weatherproof or fireproof qualities, varies too much for the committee to measure.

The Thebes Bridge Superstructure.

The double-track bridge across the Mississippi River at Thebes, Illinois, is about 26 miles northwest of Cairo, and 36 miles north of the Ohio River. It has recently been completed by the Southern Illinois & Missouri Bridge Co., Mr. Alfred Noble and Mr. Ralph Modjeski, engineers, to connect the Illinois Central, the Chicago & Eastern Illinois and the St. Louis Southwestern Railroads on the Illinois bank with the Frisco System, the Iron Mountain and the St. Louis Southern railroads on the Missouri bank of the river. Previously traffic had been maintained by car transfer boat service which was unsatisfactory, of limited capacity and subject to derangement by floods and ice.

At this point the river is about 2,700 ft. wide, between high water banks, and 2,400 ft. wide between low water banks, and has a depth of about 50 ft., subject to floods in the Ohio, Missouri and upper Mississippi. Both low water banks are 10 or 15 ft. high above low water and both high water banks are about 500 or 600 ft. in level width, 35 to 40 ft. high above low water and are crossed by concrete arch viaducts with earth embankment approaches. Between the viaducts the steel superstructure has a length of 2,750 ft. 4 in. and was authorized by an act of Congress, Jan. 26, 1901, providing for a channel span of at least 650 ft. in the clear and that all other spans over the river at bank full stage should be at least 500 ft. in the clear with a clearance of 65 ft. above extreme high water.



General View of Thebes Bridge, Looking North and East.

The bridge is one of the largest across the Mississippi River or elsewhere in this country in regard to the number of long, heavy spans, and its 671 ft. channel span is the longest trussed span, not an arch, except that of the Memphis bridge, in this country, and is exceeded by only two other bridges abroad. It has cost $2,800,000, of which $1,400,000 was for the 26,880,000-lb. steel superstructure, $600,000 for its piers and foundations, and $300,000 for the concrete arch viaducts.

The steel superstructure is made with five spans of continuous pin-connected trusses supported on six piers of ashlar masonry with foundations on solid rock, five of them with pneumatic caisson footings. The superstructure is symmetrical about the center of the 671-ft. center span, which has a 521 ft. 2 in. intermediate span and a 518 ft. 6 in. shore span on each side of it, as shown in the diagram published in The Engineering Record of Nov. 12, 1904. The piers are numbered successively from the Illinois bank; piers 2-3 and 4-5 support the 521-ft. free spans 75 ft. deep, which are intermediate between and act as anchors for the four duplicate cantilever arms 152½ ft. long, from which are suspended the three duplicate 366 ft. spans, 65 ft. deep, which have their shore ends supported on piers 1 and 6.

The trusses are 32 ft. apart on centers and have horizontal and vertical train clearances of 27 ft. 8½ in. and 22 ft. 6 in. There are rigid systems of lateral X-bracing in the planes of the top and bottom chords, sway bracing in transverse vertical planes and portals in the planes of the inclined end posts. The panel lengths are 32 ft. 6⅞ in. for the free spans and 30 ft. 6 in. elsewhere and are sub-divided by intermediate vertical posts and half diagonals to reduce the lengths of floor panels. The free spans weigh 11,560 lb. per lin. ft., the suspended spans weigh 7,720 lb. per lin. ft., and the cantilever arms weigh 11,650 lb. per lin. ft.

The design adopted was chosen in preference to an alternative design for five free spans of about the same total weight, chiefly on account of the advantage afforded for cantilever erection. The erection of the free spans on high falsework in deep water is a serious matter which could not have been accomplished in one season, and their reinforcement so as to be erected as cantilevers was not considered economical. It was admitted that the free spans would have been more rigid and perhaps handsomer than the cantilever, but they would have required wider piers and therefore have been more costly. A design with a center cantilever span, two anchor spans and two free short shore spans was considered, but would have involved a much larger number of different truss members, and the design with the greatest number of duplicate members was chosen. High towers at the ends of the free spans might have diminished the weights of the cantilever arms, but their omission allowed the use of an overhead traveler for the erection of the channel span and secured a more regular outline for the structure. The end panels of the suspended span top chords are inclined so as to allow a greater inclination of the end posts and better floor beam connection there, and to define the span and reduce the severity of the top chord line taken as a whole.

The floor system is designed for a concentrated load of 50,000 lb. followed by a train load of 5,000 lb. per lin. ft. of each track and the trusses are proportioned for 80 per cent. of this load, and for a wind pressure of 1,000 lb. per lin. ft. Medium steel with an elastic limit of 37,000 lb. or more, and an ultimate strength of 62,000 to 70,000 lb. per sq. in. is used throughout.

Typical details and a general diagram of the superstructure were published in The Engineering Record of Nov. 12 and Dec. 24, 1904, and some additional features of construction are shown by the accompanying pictures of the completed bridge. The massive portals connecting the inclined end posts of all trusses, fourteen in all, consist of top, bottom and intermediate horizontal struts with two panels of X-bracing between them, as shown in the cantilever arm and free span in the view of pier 2. Both diagonal and horizontal struts have each a pair of lattice girders with I-shape cross sections as deep as the webs of the inclined end posts and in the same planes. The lower flanges of these girders are latticed together and the upper flanges are riveted to the under sides of cover plates in the planes of the cover plates of the inclined end posts to which they are connected by end gusset plates. The horizontal top strut is made with 4 x 4 in. and 3½ x 3½ in. angles and a 43½ x ½ in. plate. The other horizontal struts and the X-brace struts are each made with a 36 x ⅜ in. plate and four 3½ x 3½ in. angles.

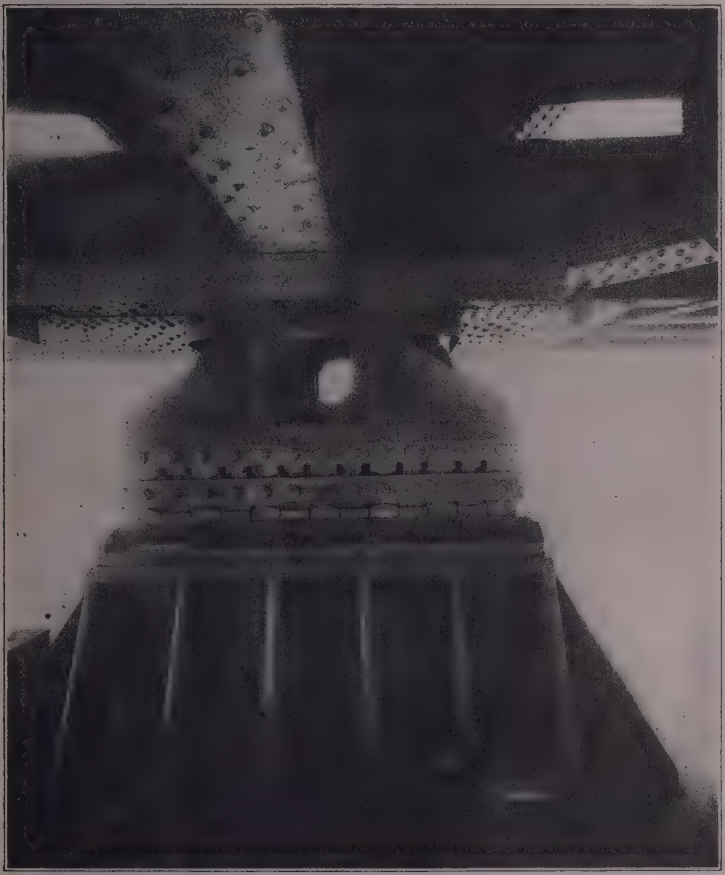
The top lateral struts at main panel points are made with rectangular I-shape cross sections built with four 5 x 3½ in. angles, latticed on all sides and having short vertical end web plates extended a long distance below the lower flange to connect with the inner face of the vertical post and receive the single 5 x 3½ in. diagonal angle. These web plates are notched to clear the top chords and have the edges of the notches stiffened by bent flange angles. In the vertical bents over the piers the bracing was of similar design, but heavier and modified, as shown at pier 2, by making the struts with rectangular cross sections built of four angles, latticed on all sides and connected to the vertical posts with pairs of web plates like jaws.

The four-web top chord of the free span is 42 in. deep and about 5 ft. wide, with single zig-zag angle-iron lattice bars on the lower flanges. It has a maximum cross section of 762 sq. in., equivalent to a solid steel bar 2 ft. 3½ in. square. The maximum tension top chord is made with ten 14-in. eyebars with a total cross section of 325½ sq. in., equivalent to a solid steel bar 1½ ft. square. The largest eyebar is 14 x 2⅝ in.

The compression bottom chords resemble the compression top chords except that they have no cover plates and that they are latticed with flats instead of angle bars. They receive the jaw connections of the vertical and diagonal posts between their inner and outer webs. The floor-beam webs are 77½ in. deep, heavily reinforced and notched at the ends, where they have bent diagonal flange angles and project above the top flanges, as shown in the detail, to afford connection with the vertical posts and clear the bottom chords. Their lower flanges are flush with those of the bottom chords and are connected to them by the horizontal plates which receive the lower lateral diagonals.

The 18-in. end lower chord pins of the free spans engage cast steel shoes, which, on piers 3 and 4, are seated on segmental steel rollers 18 in. high and 6 in. wide with rail beds on cast steel pedestals. On piers 1 and 4 the shoes are fixed and are seated directly on the pedestals, which are made correspondingly higher.

The trusses were built at the Ambridge plant of the American Bridge Co., of New Jersey, Mr. Paul L. Wolfel, chief engineer, and were erected by the Kelly-Atkinson Construction Co., of Chicago, sub-contractor under the American Bridge Co., of New York, Mr. S. P. Mitchell, chief engineer.


Expansion Bearing on Pier 2 of Thebes Bridge.

Floorbeam Connection and Detail of Lower Chord.

European Reinforced Concrete Piles.

The reinforcement for reinforced concrete piles employed in Europe naturally bears a close resemblance to that for columns. In a paper on the subject presented to the Association of Municipal and County Engineers, Mr. A. R. Galbraith says that in the Hennebique type the piles are vertically reinforced with round bars, varying from 1 to 1.57 in. diameter, connected together at proper intervals with 3-16-in. wire stirrups and distance-pieces, to keep the bars from spreading under vertical pressure. Rolled joists of I-section are used in the Rechten and Williams piles, and in the Johnston pile angle-irons are employed for the vertical reinforcement; while, in the Simplex pile, expanded metal is utilized for this purpose. The percentage of the metal varies, according to the load to be carried, from 2 to as much as 5 per cent., or oven more.

Without exception the most efficient method of column reinforcement, Mr. Galbraith thinks, is the helicoidal hooping of M. Considère, and this will undoubtedly (if it has not already been done) be soon applied to pile work. The vertical bars are invariably of small section, and are introduced to increase the rigidity of the column by their resistance to flexure. M. Considère, in some of his later experiments with columns some 12 months old, reinforced in this manner, obtained a compressive resistance of nearly 12,700 lb. per square inch before failure by crushing. With hooped concrete the loading can safely be increased up to as much as, say, 2,000 lb. per square inch. The percentage of metal used is also considerably less than that for the longitudinally reinforced columns, although the labor connected with the former is probably slightly in excess of that for the latter. This method of reinforcement is peculiarly suitable for a pile of circular section, and such a pile would offer very great resistance to oblique strains. All metal should, it is stated, receive a liberal coating of Portland cement grout before being embedded in the concrete.

Molding.—There are three methods of manufacturing piles:— *a,* In vertical molds supported by frames; *b,* in horizontal molds; *c,* in a special apparatus such as a "driving form," the piles being formed *in situ.*

When piles are molded vertically, the molds are built in stout timber frames, the internal section of the mold corresponding to the size and shape of the pile. The working faces of these molds are left open, cast-iron or steel shoes are then placed in position at the bottom of the molds, and attached by wrought-iron straps to the bottoms of the piles, these straps being bent over inwardly at their extremities to form a key with the concrete. The vertical bars are then carefully adjusted to the fiduciary line by gauges to within an inch or so of the casing, and kept in place by the connecting stirrups and distance-pieces dropped over the bars from the top to different points marked on the edge of the molds, varying from 2 in. at the bottom and top to 10 in. at the center of the length of the pile. Concreting is then commenced, a bucketful fall at a time, which must be thoroughly well rammed as soon as placed in the mold; and as the height of the pile increases, the working face of the mold is closed by shutters from 4 to 6 in. deep, running in grooves formed in the sides of the permanent casing. The faces of the molds should be invariably well soaped or whitewashed, in order to prevent any adhesion of the concrete to the woodwork. Concreting should, whenever possible, be continuous until the particular pile is finished; but when this is not done, care should be exercised to remove any loose or foreign material from the surface of the old work, and it should then be thoroughly cleansed and afterwards serrated with a cutting tool. Pure cement grout should then be poured over its surface, and the work resumed as before. Vertical molding, especially when the piles are of great length, is extremely troublesome and expensive, although the concrete has, as a rule, a greater and more uniform density.

Piles are molded horizontally in suitable framing-boards, held together by special clamps and timber cross-pieces. The clamps are formed of two pieces of rectangular iron, the longer piece being bent over at right angles to its length, its extremity being carried over so as to project for a short distance in a line parallel to its longer length, and terminating in a metal button. The shorter piece is made of similarly shaped iron, with a similar extremity sliding on the longer one so as to be adjustable to the size of the mold. The clamp is tightened by hammering up the straight projecting end of the shorter piece, and the loosening effected by the reverse process. On the reinforcement being in its proper position, concreting is commenced in a like manner to that adopted for the vertical process, the inner faces of the molds being treated as before described to prevent any adherence to the concrete. This method, although much more economical than the vertical one, has the drawback that even with the greatest care there is a great liability of the occurrence of inequalities in the density of the concrete.

After about 38 hours the concrete is sufficiently set for the molds to be stripped; and the piles are then allowed to remain from 28 to 40 days, to set preparatory to driving.

Driving.—The piles can be driven hydraulically, or by the ordinary piledriver, or a combination of both. When the nature of the strata will permit it with advantage, they can be driven with the water jet, and for this purpose a ¾-in. gaspipe is carried down the center of the pile, terminating in a ⅜-in. nozzle at the point of the shoe. Sometimes it is more convenient to introduce this pipe at the side of the pile. Experience shows that a heavy ram, with quick successive blows and short drops, gives the best results. In order to distribute the impact stresses uniformly over the top of the piles, the head is encased in a steel cap filled with sand or sawdust, a tight joint of hemp and clay being made between the lower part of the cap and the pile to prevent the escape of these materials. A timber dolly is generally interposed in the usual way between the ram and the pile head, and a separate cap is required for each size of pile. At Chantenay-sur-Loire, Nantes, France, the piles were made of plain concrete tops, designed to be broken off sufficiently after driving to expose the reinforcement for connection to the superstructure. This arrangement allows of the upper portion of the pile being loosely clamped to the guides of the driver. These sheet piles, 11.8 x 14.8-in. in section, were driven by a 3,520 lb. ram, with a fall of 6.25 ft. As an example of the excessive weight of the ram, compared with those for driving ordinary timber piles, the 16-in. square reinforced concrete piles of Hennebique design for the Brumath bridge were driven with an 8,800-lb. ram, with a maximum drop of 8 ft. The driving rig is similar to that employed for driving the ordinary timber piles, with the exception that stronger tackle is required to handle the heavier reinforced concrete pile.

Hennebique Type.—Foremost among molded piles are those constructed according to the Hennebique system. These are square in section, with a pyramidal point, the top being shouldered off and terminating in a circular head to receive the driving cap. The reinforcement usually consists of four soft iron rods, placed at the corners, and wired together at the intervals previously stated. Sometimes six reinforcing bars are employed, as in the construction of a wharf at Noverossisk, Russia. They are 15.75 in. square, and designed to carry a safe load of about 38¼ tons, in addition to the dead load represented by a section of the wharf floor having an area of 269 sq. ft. Their weight is about 262 lb. per lineal foot, from which 45 lb. per lineal foot can be deducted for the reinforcement. Bearing piles on this system have been made in lengths up to 62 ft., and a sectional area 16 in. sq. will carry a safe load of 50 tons.

In the sheet piles six bars are used. These are also fitted with semi-circular groove on either side, which extends from the upper end of the shoe to the top of the pile. At the lower end of the pile, on its longer side, is fixed a metal spur, which fits into the groove of the pile preceding it and acts as a guide in driving. After driving, these grooves are carefully cleaned out with the water jet and filled with cement grout, making a perfectly watertight joint, forming the series of piles into a solid monolithic mass.

Another variation in piles reinforced with round iron bars tied together with wire stirrups was used in the construction of the foundations of the new law courts at Berlin-Wedding. In transverse section they represent an equilateral triangle with bevelled edges, reinforced with iron bars 1 in. in diameter, connected together at regular vertical distances of 10 in. by ¼-in. wire eyebars, set into the concrete with a blunt point at their lower end. At the bottom of the pile the three bars converge to a point, and are welded together. The proportion of the concrete was one of Portland cement to three of river gravel. This concrete, slightly wetted, was carefully prepared in a pug mill, and deposited in vertical wooden molds in layers 8-in. in thickness, which layers were afterwards compressed to about half that amount. Prior to fixing the ties and adding fresh concrete the surface of each preceding layer was roughened, so as to ensure a thorough homogeneousness of the whole mass. The piles were then left for a period varying from twelve to twenty-four hours, and for the following seven or eight days were frequently and copiously watered. They were then removed from the molds, and again watered for eight or ten days, being then sufficiently hardened for transport to the works, where they remain for about a month longer, and are ready for driving. They were driven by a steam piledriver through poor and treacherous soil, with a ram weighing 2½ tons, falling 5½ ft. Their length varied from 17 to 26 ft., and, to prevent their heads being damaged by the ram during driving, they were protected by a buffer built up of sheets of lead, plates of iron and timber packing, all held together with an iron ring.

Mouchel's Hollow Pile.—M. L. G. Mouchel, the pioneer and representative of the Hennebique system in England, has introduced a light hollow pile, vertically reinforced with iron bars of circular section, to which are connected at the required intervals the horizontal reinforcement, consisting of iron diaphragms, distance-pieces and wire ties. The cavities in this pile are formed of concrete molds, built in during manufacture. They are lighter and equally as strong as the other piles, and therefore offer special facilities for handling and transporting finished piles.

When any of the piles reinforced with round bars are of insufficient length, or a joint or junction has to be formed, extra bars can be added by overlapping them for a distance equal to 24 times their diameter. Another method is to cut off the ends of the rods die-square, and abut them against one another, adding a sleeve of iron tubing over the joint, thus ensuring a uniform resistance. The tops of the reinforcing rods are usually covered with about 1½-in. of concrete.

Johnston Pile.—Mr. Andrew Johnston, of the Armoured Construction Co., has patented a reinforced concrete pile, the salient features of which are the vertical reinforcement of 2 x 2 x ⅜-in. steel angle-irons, connected to 1¼ x 3-16-in. iron bands and to ⅛-in. steel wire diaphragms, the latter being designed to counteract the shearing stresses. The lower end of the pile terminates in a steel shoe. These piles are from 40 to 50 ft. in length, and 18 x 12-in. in cross section, the reinforcement being 2 in. from the surface of the concrete. They were designed for a wharf on the Thames at Rotherhithe.

Rechten Pile.—The piles of the Rechten, Vereng and Dopking system are reinforced with rolled steel joists framed together. The reinforcement in piles for a quay wall consists of two parallel I-beams, connected at intervals of 7.7 ft. with plate and angle cross-ties. One of the narrow faces is grooved, and the other has a tongue for the purpose of interlocking with the adjacent piles when employed as sheeting. An anchor rod at the top of the pile is connected to a massive concrete anchor buried in the firm ground at the rear of the quay. In driving, a timber dolly or false pile is used, with a hemp cushion interposed between the dolly and the pile head in the usual way. These piles are generally molded horizontally.

Williams Pile.—Mr. A. E. Williams, of Dagenham Docks, Essex, is the inventor of a pile in which the vertical reinforcement is composed of a rolled steel joist (9¼ x 4-in, weighing 20½ lb., in a 14 x 14-in. section) embedded in concrete. This joist can be fitted with a cast-iron shoe, but it is considered preferable to cut a triangular piece out of the web of the joist, and then bend the flanges in until they meet, cutting off the corners to form a point. The concrete is further strengthened horizontally, at intervals of about 1 ft., with rough hoops, 11 in. in diameter, formed of 3-16-in. steel wire. The weight of a 14 x 14-in. standard pile is about 2 cwt. per lineal foot. When flexure is likely to be set up by oblique strains, acting at right angles to the web, they are stiffened by the addition of two flat steel bars on either side, acting as trusses. These bars can be curved if desired, and their addition entails an extra cost of only 3d. per foot cube. To facilitate the handling of the piles, three holes are drilled at different points on the center line of the web, extending right through to the surfaces of the concrete, and lined with 2-in. boiler tubing. The first of these, which is also used as a gauge bolt-hole, is situated about 2-ft. from the top of the pile; the second and the third being placed at points one quarter of the length of the pile on each side of the center respectively. These holes are used for slinging the pile into a horizontal position, making it possible to handle them within seven days after manufacture. The concrete is compounded of clean shingle, which has been rejected by a ¼-in. but has passed a ¾-in. mesh sieve, mixed with half its volume of clean, sharp ¼-in. sand. This is mixed dry with 200 lb. of Portland cement to every 9 cu. ft. of the aggregate, it is then sprinkled with water, turned over by hand, and afterwards passed through a special form of pug mill, until the concrete is in a plastic condition, and it is then ready for use. Joints are formed by breaking away the concrete from the joints for a depth of about 18 in., to this is added a piece of joist for the required length fished to the infra-incumbent pile. Molds are then framed round, and the concrete is rammed in, making a continuous pile from the point to the top of the work. For driving, a 2-ton ram, falling 6 or 8 ft. is used; and the heads of the pile are protected with a temporary cast steel cap, above which is a hardwood dolly about 3 ft. long.

Some Problems in Steam Turbine Design.

The value of scientific knowledge and methods in developing inventions has been the subject of so much general discussion that little is left to say except in stating specific instances, which prove the truth of the assertion. The rapid development of apparatus so novel as the steam turbine has only been possible by the use of scientific design, as pointed out by Prof. Louis C. Loewenstein in the "Journal" of the Franklin Institute recently. He pointed out that we might refer in proof of this assertion to the importance of previously determining the exact dimensions of a rotating wheel whose periphery almost reaches the velocity of a bullet, in order that the existing stress in the material will not at any place exceed the allowable limits. Or, again, how disadvantageous it would be in the case of the horizontally rotating disc wheels that have lately come into use, and whose diameters attain considerable dimensions, to determine, experimentally, after first constructing, how much the discs deflect on account of their own weight, and how much they again straighten out, due to their centrifugal force; the latter a point of great importance, if we consider the scraping of the blades in the narrow clearance. What dangers the designer risks when he attempts the building of steam turbines without having exact knowledge of the phenomena of the so-called critical velocity.

Among the important scientific investigations that must be made by the designer of steam turbines, Prof. Loewenstein mentioned the flow of steam through orifices, nozzles and blade channels; the friction of rotating discs in a steam medium; mass balancing and the theory of the flexible shaft; critical velocity and period of oscillation due to elasticity; the deviation of rotating discs due to the bending of the shaft; the deflection of horizontally rotating discs and the action of centrifugal force upon them.

It is well known if steam, or in general any elastic fluid, flows through a simple orifice from a space of higher into one of lower pressure, the pressure in the orifice will decrease to about one-half the initial pressure, and there will occur in the stream after leaving the orifice strong acoustic vibrations. These vibrations cause a considerable loss of efficiency, and they must be avoided. De Laval has accomplished this by adding to the orifice a conically diverging nozzle in which the steam can continuously expand down to the back pressure. Before the design of the nozzle can be undertaken it is necessary to fully understand the flow of steam in nozzles. Experiments were made to investigate this flow, and Prof. Loewenstein described briefly how they were conducted and the results derived.

An orifice of a nozzle through which the flow of steam was to be investigated was so mounted that a thin measuring tube could be inserted through the center of the opening. One end of this measuring tube was closed and the other end was connected with a pressure gauge. In the middle of this tube a hole was drilled at right angles to the axis. By means of a micrometer screw this tube could be moved in one direction or the other, so as to bring the measuring opening in any position of the nozzle axis. Experiments were first made to ascertain how reliable this method would be for the measurement of pressure, for as can be seen, it is not sufficient to place a measuring opening tangential to the flow of steam, but the position and the condition of the edges of the opening may be responsible for a disturbing effect. These experiments showed, however, that the readings taken in this manner could not materially differ from the true pressure. By now allowing steam to flow through orifices and nozzles of various shapes it was possible to plot a curve of pressure showing the variation of pressures throughout the length of an orifice or nozzle, and even beyond it. Some very interesting and important results were obtained.

The resistance to steam flow was first investigated, and after a great many experiments were made the conclusion was reached that it is allowable to consider the resistance to steam flow in a diverging nozzle as simple tube friction. With nozzles of small divergence and less than 2-in. long and about ¼-in. minimum diameter the loss of energy was about 10 per cent., and with nozzles of greater divergence and about 4-in. long and ⅜-in. minimum diameter the energy loss was 15 per cent. The decrease of velocity is about half as great.

Through partly closing a valve placed between a nozzle and a condenser it is possible to produce any desired back pressure. In measuring the pressure in various parts of the nozzle, the pressure first follows the line of free expansion and then increases according to the value of the back pressure in more or less sudden leaps. In these extraordinary heavy increases of pressure we find a realization of the theoretically derived "compression shock" of von Riemann. The steam particles possessed of great velocity strike against a slower moving steam mass and are therefore compressed to a higher degree. Such compression shocks will always occur when the nozzle has a greater length, that is, a larger cross-section divergence, than the initial and the final pressures demand.

Other experiments were made on the flow of steam through orifices. These experiments gave the desired explanation of the phenomena of flow from orifices. Messrs. Mack and Emden proved by means of photographs the presence of regular successive light and dark lines in a steam flowing from an orifice, which cannot be said to be anything else but acoustic waves; but as to the value of the existing pressures in this stream we were totally in the dark. Emden assumed that at places of compression the same condition exists as in the orifices, but he further said in contradiction to himself that there exists the same pressure at every place in the steam as exists in the surrounding atmosphere, and claims that there is a change of density. According to this, for instance, for air, places of smallest velocity, that is smallest energy, must coincide with places of smallest temperature, that is, smallest potential energy, which, Prof. Loewenstein says, is obviously impossible. By his calculation he further believed to have proved that the difference between the initial and the orifice pressures can only be used to produce the additional velocity of flow; the remainder of the available work is transformed into acoustic energy. The experiments lately made by Professor Stodola contradict these opinions; they prove that the steam first expands to the existing pressure before the orifice, that therefore the first rush (as in the case with suddenly releasing a compressed spring) too much potential energy is changed into kinetic energy. Only this excess changes into acoustic vibrations and is rechanged into heat at the rim of the stream by friction and eddy currents. The oscillations occur in the axial direction as well as in the radial. The stream flows at the pressure of the orifice into a region of much smaller pressure, begins therefore to expand in a radial direction. The resulting drop of pressure accelerates the particles also in the axial direction. Steam flowing from a diverging nozzle shows the same phenomena as from a simple orifice. With varying back pressure it was found that the steam on leaving the nozzle gave very regular acoustic vibrations, but it was possible to so fix the back pressure that every trace of a vibration disappeared.

From these experiments it is finally determined that the steam in a nozzle expands nearly adiabatically independent of the back pressure. If the steam flows into a place in which a back pressure exists exactly equal to the final pressure of expansion then the pressure in the stream is not changed at all. If the pressure is lower, acoustic vibrations occur, as with a simple orifice; if the back pressure is too high, a steam shock occurs with more or less drawn out oscillations. By entirely filling out the cross-section of a diverging nozzle, a vibration is made difficult, if not entirely impossible. Prof. Loewenstein believes we can hardly go wrong if we say that the drawn-out vibrations occurring in a simple orifice are caused primarily by the sudden difference of pressures at the stream's rim and the surrounding atmosphere, which the stream quickly spreads. There is, therefore, the possible assumption that when vibrations still occur in the interior of the nozzle, the stream has detached itself at such places from the wall.

If the nozzle is constructed according to the formula of Zeuner, the final pressure will be greater than the prescribed back pressure, because friction transposes the kinetic energy into heat, and the expansion line will rise above the adiabatic. A nozzle calculated, therefore, according to Zeuner would actually be somewhat too long. This fact was soon recognized. To correct this Rateau, and after him Delaporte, proved by experiments that the pressure of a stream on blades or suitable plates decreased very little if the nozzles were made shorter; that is, the stream is allowed to flow out at a slight over-pressure, and recommended this to be done. It remained for Stodola to prove by his experiments just mentioned that violent acoustic vibrations would then take place in the stream, and that these must be avoided. It is important to make the nozzle dimensions suitable to the assumed back pressure. Before correct nozzle dimensions can be determined we must know from experiments the probable steam friction loss in the nozzle and then the design of the nozzle is easily accomplished.

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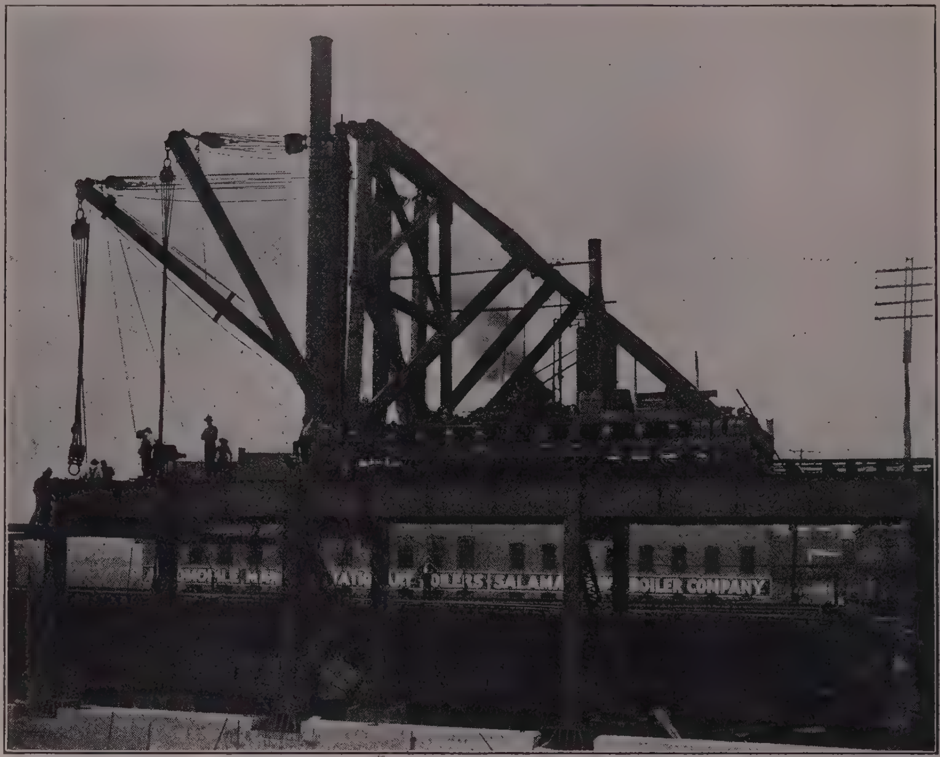
In conclusion, Prof. Loewenstein pointed out, that in the steam turbine we are confronted with an entirely new series of phenomena. The knowledge of steam accumulated by familiarity with the reciprocating engine is of little use in designing this newest yet oldest of prime movers. Nor can the cut-and-dry methods that have brought the reciprocating engine to its present stage of excellence be employed in the steam turbine. Modern commercial conditions are such that design must be based on ascertaining physical laws. This rapid advance has necessitated the re-investigation of steam from the point of view of velocity instead of pressure, of kinetic energy instead of potential, and the friction of rapidly moving bodies against a vapor instead of a lubricated surface, of the balancing of parts so that they shall revolve about their center of gravity, and of numerous other questions which are but beginning to make themselves felt. The available data are few, and practically all of the information is scattered through the pages of German and French scientific periodicals and a few scientific books.

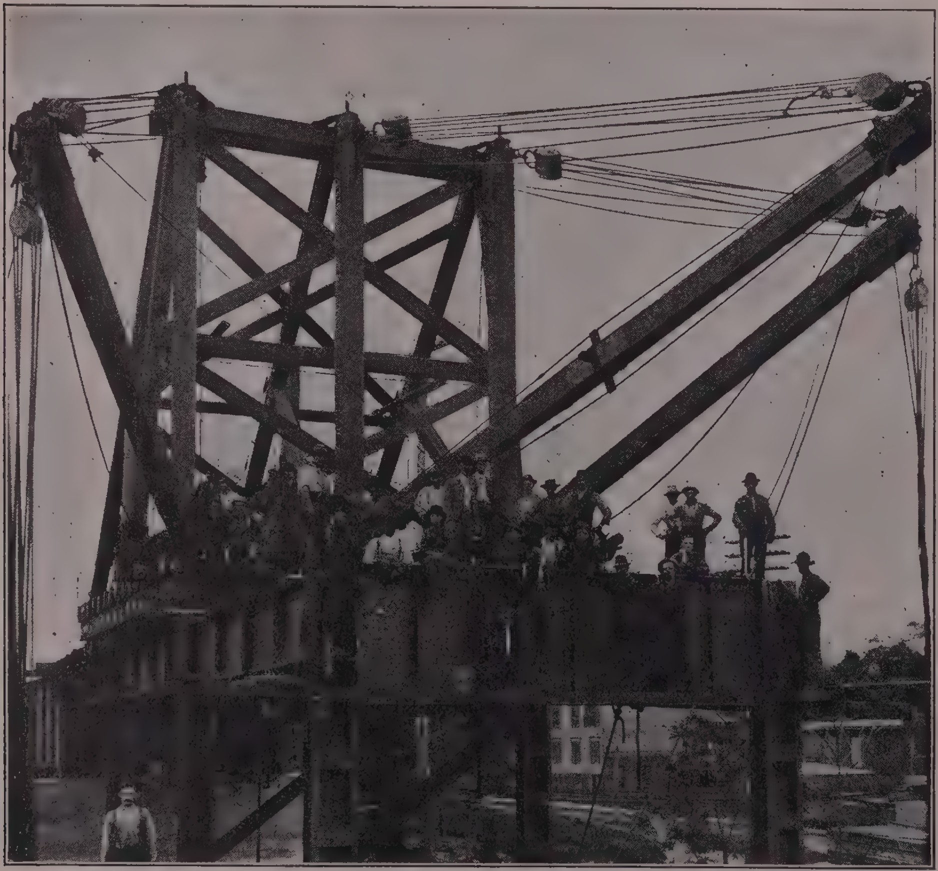
The Newark Viaducts of the Lackawanna Railroad.

The elimination of grade crossings of the Delaware, Lackawanna & Western R. R. tracks in Newark, N. J., has involved both the elevation and depression of tracks, as described in The Engineering Record of Nov. 12, 19 and 26, 1904. Part of the track elevation is on earth embankment between longitudinal retaining walls, but at the principal streets and near the Passaic River, the tracks are carried on plate girder spans, supported on steel column transverse bents and masonry abutments. Between the Passaic River and the Broad Street, Newark, station, there are six separate structures of an aggregate length of 870 ft. 9¼-in. and a total weight of 3,320,012 lb. as follows: West approach span, Passaic River, 105 ft. 7 in., 536,871 lb.; viaduct Passaic River to Ogden Street, 189 ft. 4⅞ in., 494,295 lb.; Ogden Street passenger viaduct, 72 ft. 3 in., 195,330 lb.; Ogden Street viaduct to arches, 289 ft. 9⅞ in., 790,795 lb.; Broad Street bridge, 111 ft. 8½ in., 775,983 lb.; Plane Street bridge, 102 ft., 506,738 lb. They are designed for two and three tracks with heavy trains at high speeds.

The Ogden Street passenger viaduct is a double-track structure on a 2 deg. curve, with seven transverse bents, from 25 to 30 ft. apart on the center line, and four lines of plate girders, 38 in. deep, web connected to the columns and to transverse girders 45 in. deep. The transverse girders have a clearance of about 17 ft. above the base of rail of a single line of freight track between the columns on the surface of the ground, and are field-riveted through their end vertical web stiffener angles to the faces of the vertical columns to which they are also connected by solid-web knee braces. The columns have I-shape cross sections made with a pair of 15-in. channels, a 14x½-in. web plate in the plane of the transverse girder, and four 6x6-in. flange angles. They are seated on cast-iron pedestals and masonry piers, and are braced together longitudinally with lower horizontal struts and diagonals to make alternate towers and open panels, except the bent nearest the street crossing, which is unbraced. The longitudinal girders all have fixed end bearings except at one bent near the center of the viaduct and at the abutment at the Ogden Street crossing, where expansion is provided for. At the former place pockets are riveted to the webs of the transverse girder and to the face of the columns, and have horizontal bottom plates on which the lower flanges of the girders slide. They are not bolted at these points, but the flanges just clear the vertical side plates in the pockets and are guided by them. Over the Ogden Street abutment the sliding ends of the girders take bearing on brackets riveted to the ends of the street crossing girders. The pair of longitudinal girders for each track has top and bottom flange zig-zag lateral angles in opposite directions.



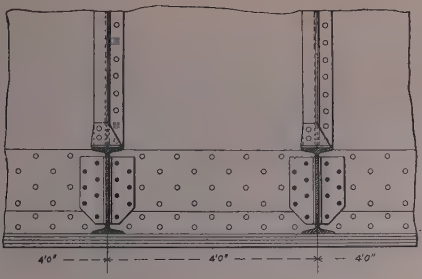
Completing Advance Panel of Newark Viaduct Erection.



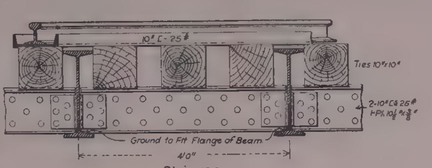
Three-Boom Traveler Advancing on Last Span of Newark Viaduct.

The viaduct is continued across Ogden Street by a skew span corresponding to the viaduct spans and having four girders 98-in. deep and 72¼ ft. long over all, which are the lines of the viaduct girders. The girders weigh about 40,000 lb. each, and one girder in each pair has fillers on the top flange to raise the track ties and provide the required elevation of the rail. The ties are dapped over the girder flanges and fillers, and the rails are laid on the webs of 10-in. longitudinal channels, spiked to the ties, flanges up. Adjacent to the viaduct span there are two single track through freight bridges at different skews. Each has a center span about 38½ ft. long, supported on four vertical columns on the curb lines, and two side spans from 13½ to 14 ft. long, supported at one end of the columns, and at the other end on abutment walls outside the sidewalks. Transverse 20-in. 95-lb. I-beams, about 3½ ft. apart, are connected to the girder webs at right angles to them, and carry the track rails across their top flanges. Two lines of longitudinal stringers, eccentric with the bridge axis and concentric with the track rails, are web connected to the transverse beams, flush with their lower flanges. Each stringer is made with a pair of 10-in. channels riveted together, back to back, with a 10x½-in. vertical plate between their webs. The street ends of the short girders are riveted to the ends of the long girders through their vertical angles, and the abutment ends are seated on cast-iron fixed pedestals proportioned to reduce the masonry pressure to 340 lb. per sq. in.

West of Ogden street there is a two-track viaduct about 292 ft. long, with four lines of girders spaced 3 ft. 3 in. and 9 ft. 9 in. from the center line. There are five spans of 35 ft., two of 25 ft., and one each about 35 and 32 ft. At one end the girders are carried on the brackets of the Ogden Street girders, and at the other end they have



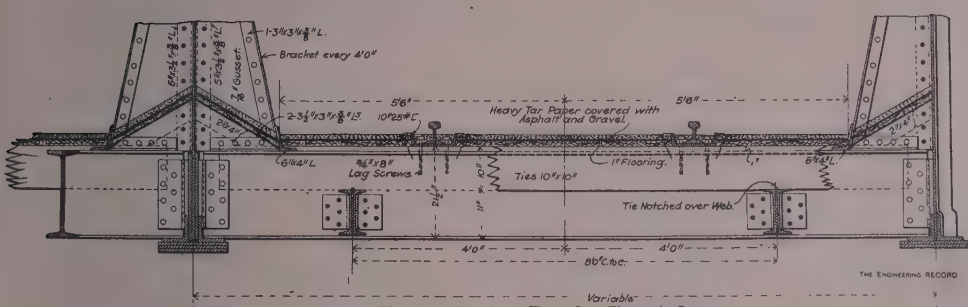
Connection of Floorbeam to Girder



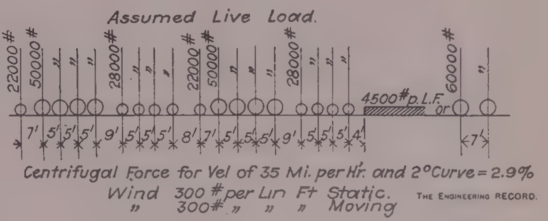
Stringer

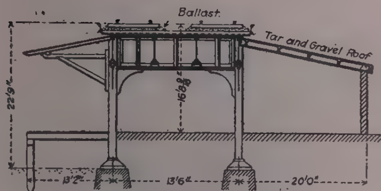
fixed cast-iron pedestals on the concrete abutment, or end pier of a series of concrete arches which intervenes between this section of the improvement and the Broad Street crossing. The intermediate supports are on transverse bents, made with pairs of short vertical posts, cross sections having two channels, four 6x6-in. angles and one 14-in. web plate. The top of the columns are connected by transverse girders 4 ft. 8 in. deep, which in four bents have solid-web knee braces, obviating the necessity for sway brace diagonals, which are used in the other bents. The latter bents are braced together longitudinally in pairs to make towers with horizontal and diagonal struts.

Four of the 35-ft. spans of the viaduct are included between the end walls of the express building and the viaduct floor there is made solid and waterproof to serve as a part of the roof for the building. These column bents are all unbraced, except for the solid-web knee braces already mentioned, and similar ones which engage the ends

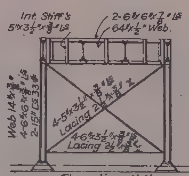


Standard Shallow Floor for Through Spans.

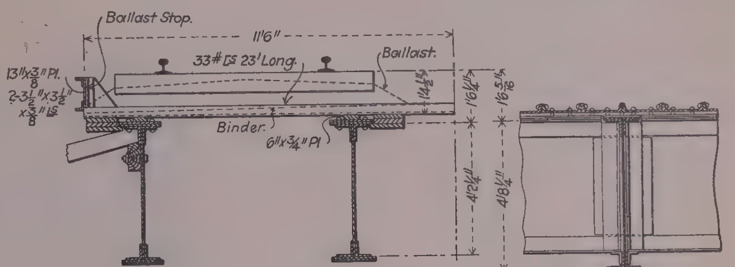




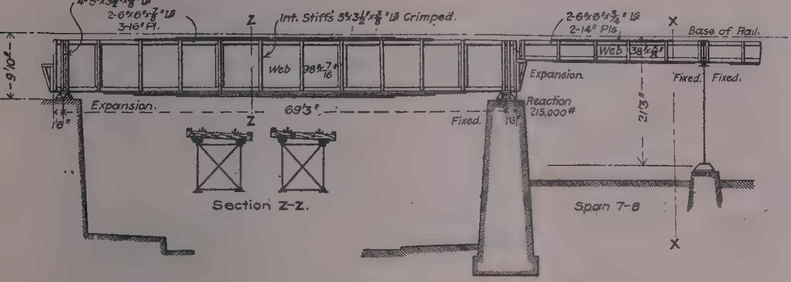
Transverse Bents in Express Building.

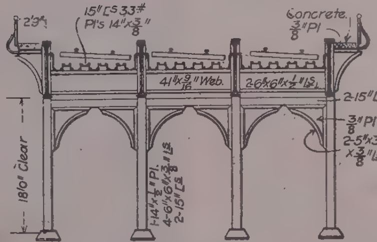


Elevation X-X.

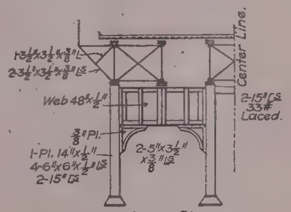


Waterproof Solid Floor in Express Building.

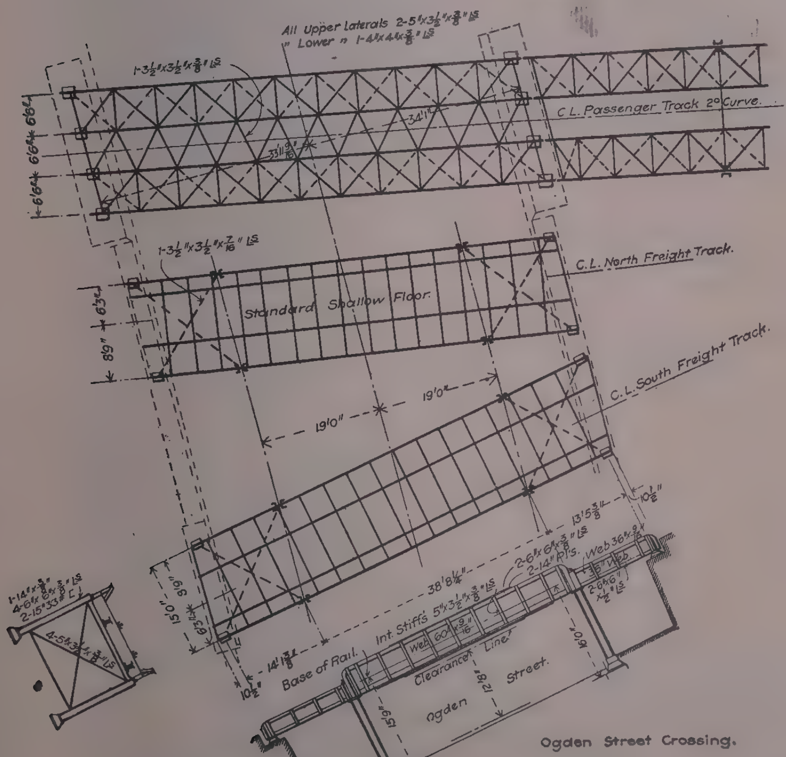




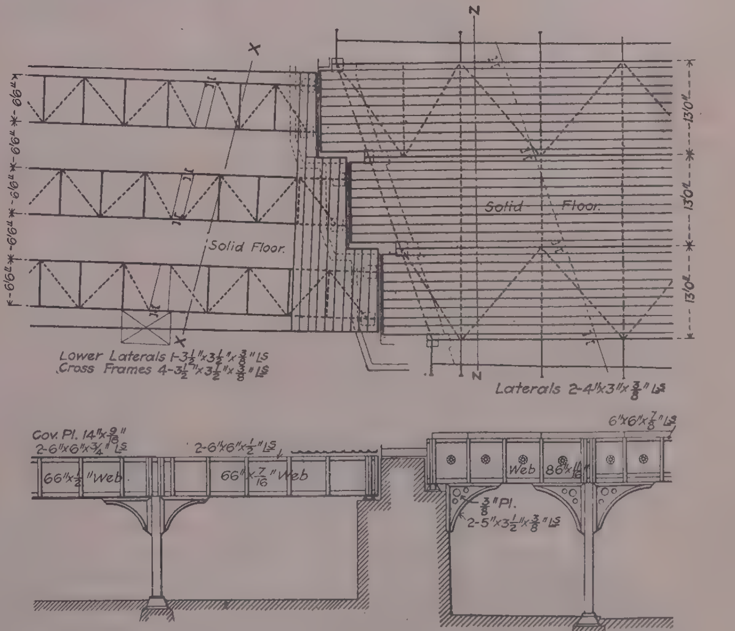
Section Z-Z



Plane St.
Half Section X-X.


All Upper Laterals 2-5"x3½"x⅜" Ls
" Lower " 1-4"x4"x⅜" Ls
1-3½"x3½"x⅜" Ls
C.L. Passenger Track 2° Curve.
1-3½"x3½"x7/16" Ls
C.L. North Freight Track.
Standard Shallow Floor.
C.L. South Freight Track.
19'0"
19'0"
Int. Stiff's 5"x3½"x⅜" Ls
Base of Rail.
Clearance Line
Ogden Street.

Ogden Street Crossing.



Broad and Plane Street Crossing.

THE ENGINEERING RECORD.

DECK AND THROUGH SPANS WITH TROUGH FLOOR AND STANDARD SHALLOW FLOOR OF NEWARK VIADUCT.

of the outside longitudinal girders. One row of columns is seated on the continuous wall for the street loading platform of the building, and the other row has separate concrete piers. The two inside longitudinal girders are web-connected to the transverse girders, and the outside girders are field-riveted to the faces of the columns.

Beveled wooden nailing pieces are bolted to the webs of the outside girders to receive the upper ends of the rafters for the side roofs and 6x¾-in. filler plates are set between the two rows of rivets in the top flanges to receive the transverse floor channels countersunk riveted to them and riveted together through their flanges. These channels are shop-riveted together in sections of convenient length for shipping and make a continuous solid deck, which required no field-riveting except through the flanges at the ends of the sections. The channels are secured to the girders by wooden filler pieces and bearing clips which are bolted to the former about 30-in. apart and engage the under sides of the girder flanges. The ends of the channels are stiffened by fascia girders connected to them by gusset plates riveted between the channel flanges and the upper sides of the channel webs are covered with asphalt binder, pitched from the center to the ends. Stone ballast is placed over the deck and the ties are set in it in the usual way.

The Broad Street crossing is separated from the Plane Street crossing only by a skew concrete pier, each side of which there are three three-track spans, from about 19 to 68 ft. long. On the Plane street side there are six lines of girders in three pairs, each pair carrying one track and supported on skew transverse bents with longitudinal and transverse solid-web knee braces at each post. Each bent has four vertical posts and two transverse girders, as indicated in the half elevation, and the solid floor is made with transverse channels, as already described.

Over Broad Street there is a long center span and two short end spans over the sidewalks, and the ends of the center span girders are seated on the caps of two four-column skew transverse bents. The four lines of through girders are connected by transverse floorbeams perpendicular to their webs and have zig-zag lateral angles between the lower flanges of the outer pairs. The floorbeams support, across their top flanges, a solid trough floor of 12-in. channels and 14-in. vertical plates. The troughs are covered with asphalt binder and filled with stone ballast, and at the ends project over the tops of the abutments, and are closed by vertical transverse plates to retain the ballast. The ends are cut in short square offsets, which are included between the oblique sides of the piers.

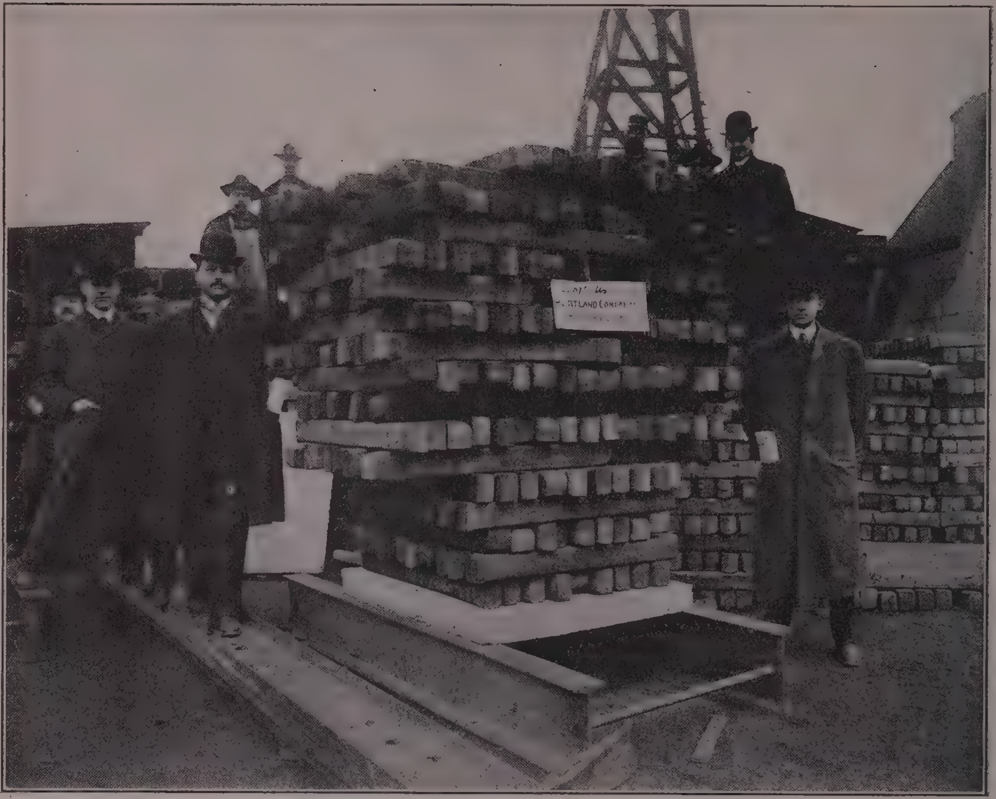
The shallow floor shown for the freight spans of the Ogden Street bridge is the standard construction for through plate girders with limited head room on the Delaware, Lackawanna & Western R. R. The floorbeams have the same depth of 20-in. and are 4 ft. apart for all spans, but their weight varies according to the distance between centers of main girders, and is 65 lb. per ft. for 13 ft., 80 lb. for 14 ft., and 100 lb. for 15 ft. They are web-connected to the girders with their lower flanges bearing on the girder flange angles. The connection angles are set ¼ in. beyond the ends of the beams so that there is no danger of the beam webs touching the girders, and the connection rivets are calculated to carry all the load without allowing the flange seat-bearing to be loaded. The stringers have an I-shape cross section made with two channels, back to back, with a plate riveted between their webs and projecting beyond their top flanges ½-in. to form a rib engaging a saw cut in the bottom of each tie and preventing the latter from slipping. Longitudinal channels are laid, flanges up, on the ties and form continuous beds for the rails, and are held in position by lag screws through cast-iron clips, which secure the rails to the ties, thus serving the double purpose of continuous track plates and to prevent the longitudinal displacement of the ties. The ties extend nearly the full length of the floorbeams and are decked with 1-in. longitudinal boards laid close, sloped up at each side at an angle of 30 degrees, and covered with tar paper, asphalt and gravel. The steelwork was delivered on flat cars alongside the new structure, and as the heaviest pieces were the 20-ton girders, it was easily unloaded and handled by the traveler booms as assembled. The erection was done by an overhead traveler assembling one panel in advance of the finished structure on which it was supported, in the way usual for elevated railroads. The traveler was built entirely of wood and had a horizontal platform the width of the two-track structure. At the front end of the platform was a three-post transverse vertical bent, braced as shown in the photographs, and fitted with two 30-ft. and one 50-ft. boom, all rigged with six-part tackles operated by a single Lidgerwood hoisting engine. The erectors were followed as closely as possible by six four-man riveting gangs, who drove the field rivets with Chicago pneumatic hammers, operated by a compressor mounted on a car in the rear of the traveler.

The viaducts were designed and constructed under the direction of the engineering department of the Delaware, Lackawanna & Western R. R., Mr. Lincoln Bush, Chief Engineer. The substructure west of the Passaic River was built by F. D. Hyde & Co., and that east of the Passaic River was built by the railroad company's forces and by Sandford & Harris. The steelwork was fabricated at the Pencoyd plant of the American Bridge Co. and was erected by Mr. W. J. McNeeley.

Gas and Steam Stations of about the same size are operating near each other in Guernsey, and in a paper before the Leeds Section of the Institution of Electrical Engineers, Mr. H. Campbell compares the working costs of the two, to the marked advantage of the gas plant, which uses 1.67 lb. of coal in the produced per brake horse-power developed.

Test of Concrete Bridge Floors.

The State Bridge at Ulster, Pa., designed by Mr. Herman Laub, has nine spans and is 2,005 ft. long. The total width of the roadway is 18 ft. 6 in., and will have a floor of reinforced concrete slabs carrying a brick pavement. The specifications for the roadway required the slabs to be strong enough to carry 1,000 lb. per square foot with a factor of safety of three. The trusses are 21 ft. apart on centers and the panels are 18 ft. 3 in. The slabs are carried by a 3x3-in. shelf angle running along each bottom chord and by four 12-in. I-beam stringers. The slabs are 4 ft. wide and either 3 ft. 7⅛ in. or 7 ft. 2¼ in. long. Three slabs, one short and two long ones, are used in each 4-ft. strip across the roadway, and the short slab is placed at alternate ends of the strips so as to cause a breaking of the joints in the successive strips. Each short slab is supported at the ends only, while the long slab has a support at the center also.



Test of Reinforced Concrete Slab for Bridge Floor.

The slabs are 4 in. thick and each contains five 1½x3/16-in. rods running nearly its full length, and spaced uniformly. They are punched with a single hole at each end, and a ¼-in. round rod is passed through the holes at each end, making a sort of gridiron of the reinforcement.

A test of a 4x3-ft. 7 in. slab was made by the Pittsburg Testing Laboratory to determine whether the required strength was obtained by this type of construction. The concrete was made of 1 part Portland cement, 2 parts sand and 4 parts gravel. The slab was supported on 12-in. I-beams exactly 3 ft. 7 in. apart on centers, so that the bearing at each end was a surface 4 ft. long and 2¾ in. wide. The loading was done with 185-lb. billets 43 in. long laid lengthwise of the slab as shown in the illustration.

A load of 19,425 lb. was applied before any crack appeared. The first crack was a fine one about 12 in. from the nearest I-beam. It was noticed at but one side and ran up about 2 in. from the bottom. When the load was increased to 29,415 lb. a second crack 2 in. long appeared on the same side of the slab near the other I-beam. The loading was then raised to 36,075 lb., when the cracks mentioned opened out to about ⅛ in. and slight cracks appeared on the other side of the slab 8 and 12 in. from the beams. The addition of enough billets to raise the load to 46,875 lb. produced no further cracking. A number of blows were then struck on the flanges of the beams, producing a heavy jar, which caused the bearing surfaces of the slab to crack and crumble. The slab did not give way, however, until the beams were forced apart 2½ in. at one end; this end then collapsed, although the other remained intact. The total unsupported area of the slab was 125 sq. ft., so that the load of 46,875 lb., which failed to cause collapse, was equal to 3,750 lb. per sq. ft.

These slabs are made by the Portland Concrete Co., of Pittsburg, and are a substitute for steel buckle plates covered with concrete. The reinforced concrete floor is less expensive than the other and these tests show that it is of ample strength for its purpose. The use of a brick pavement with pitch joints on such a structure is unusual.

Water-Powers of the Southeastern Appalachian Region.

Few sections of the country are receiving so much attention from capitalists to-day as those in the southeastern Appalachian region. The great resources of this section include an abundance of water power which suffers, in fact, from the competitive amount available when developed by competent engineers and conserved by intelligent forestry on the catchment basins. In a valuable paper on this subject read before the recent convention of the American Institute of Electrical Engineers, Dr. F. A. C. Perrine pointed out that the Appalachian mountains are neither as high nor as rugged as the Rockies and Sierras and their streams are consequently different from those developed by some of the famous works in the West. Most of them are rounded hills, covered with earth and vegetation to their summits, and none of them reaches up to the snow line; they form, however, the fountains for watering the fertile plains below, which on both sides lie at their base.

The chain extends from Maine to the Gulf, and comprises the White and the Green Mountains of the north, the Adirondacks and Alleghenies in the Middle States, and the Shenandoah, Greenbrier, Blue Ridge, Black, and Great Smoky mountains of the South, with many auxiliary ranges. In the states of Virginia, North Carolina, and South Carolina, they lie massed on the western border. and about the northern border of Alabama and Georgia, and form the eastern boundary of Tennessee, Kentucky, and West Virginia. In consequence of their location they form an important element in the life and industries of each one of these states, which for fertility have been renowned, and no unimportant element in their fertility is due to the water that flows from the mountains. As in the past the agriculturists of the South have blessed the waters, so to-day, and in the future, the manufacturers of the South will praise the mountains for the waterfalls furnishing power and forming one of the most important elements in the rebuilding and new development of the Southern States. In his paper, Dr. Perrine confined himself to the consideration of the powers in the states of Virginia, North Carolina, South Carolina, Georgia, and Alabama, since in these states the most wide-reaching effect seems to wait upon the development of these waters.

On account of the physiographic characteristics, which have already been touched upon, this region is preeminently a water-power country. The rainfall over its entire extent is in no part less than an average of 35 in., increasing to 60 in. in the mountains. This precipitation does not occur in a wet season of limited duration, but is well distributed throughout the year. The soil itself is generally porous, and for those streams from the head waters of which the forests have not been cut the rainfall is retained, and neither the floods nor the low waters are as serious difficulties as are encountered in the Middle States.

Ice and snow are not important elements in the problem, which is not only a condition favorable to hydraulic development, but also to the problems of transmission-line maintenance. The rivers draining this territory fall rapidly to a well-defined fall line where they enter the plains along the sea-coast, and in some cases become navigable; above the fall line they present many opportunities for power development, of high head in the mountain region, and of low head between the mountains and the fall line along which portions of their course they flow over many rapids which in that region are called "shoals." The greatest difficulties to be encountered are those due to lightning storms, which are frequent and severe over the whole territory and present a serious problem to the designing engineer.

On account of the generally loose character of the soil throughout almost the entire territory the rivers carry immense quantities of silt, which must be considered in planning canals and other hydraulic work. Commercially the fact that Southern industries rarely operate more than 11 hours per day requires a most careful study of the opportunities for storage, which will enable the full use of the river during this working period of each day. There are few locations presented in this region for storage reservoirs sufficiently large to enable the full use of the average yearly run-off.

The most serious commercial problem present in this region is that of competition. On account of the abundance of water and the number of power sites, there are few, if any, powers in the entire region so situated as to be immune from dangers of competition from powers of equivalent cost of development and equal accessibility to the market.

This condition seems to require in this region, more than in any other part of our country, the development and distribution of the powers from many plants under one common management. If attacked in this manner the solution of the water-power distribution in the Southeastern Appalachian region offers great opportunities of commanding success, and by duplication of plants reduces the necessity for duplication of lines and tends to make the power more useful and reliable.

Such a procedure also tends to aid in the solution of another problem presented by the long period of minimum flow common to the rivers of this region. While the period of minimum flow is long, the steadiness of a flow 50 to 100 per cent. above the minimum may be generally depended upon for certain seasons of the year, and in the successful plant this excess flow must be utilized.

The manufacturers of the South, as in New England, have for many years been accustomed to appreciate the value of water power to their steam plants, and of the steam plant as an auxiliary to the water power; in consequence, a market for power beyond the amount of the minimum stream flow is readily obtained, and should always be considered in planning for developments in this territory. The particular importance of this appears from the fact that a great proportion of the plants in this territory are constructed directly at the dam site, with little or no canal or penstock construction required, and entailing little expense for the development of excess power except the actual cost of the machinery and its foundations, with the necessary covering roof for including it in the power house.

The principal rivers of the Southeastern Appalachians, whose drainage basins need to be considered in studying the water-water opportunities offered, are the James, Roanoke, Staunton, and Dan Rivers, in Virginia; the Cape Fear, Yadkin, and Catawba, in North Carolina; the Catawba, Broad, Saluda, and Savannah, in South Carolina; the Oconee, Ocmulgee, Flint, and Chattahoochee Rivers, in Georgia; and the Tallapoosa, Coosa, Tuscaloosa, and Tombigbee Rivers, of Alabama. Each of these rivers has many tributaries of importance, and in the enumeration of the rivers in this region a difficulty is presented by the fact that some of them change in names as they flow from source to mouth. For example, the Catawba River of North Carolina is the Wateree River of South Carolina, and flows into the ocean after its junction with the Congaree as the Santee; similarly, the Mobile River of Alabama is formed by the junction of the Tombigbee and the Alabama, and although the former retains its name to its source, in spite of being joined by the Tuscaloosa, the Alabama above Montgomery becomes the Coosa, and the Tallapoosa and the Coosa at Rome split into the Etowah and Coosawattee.

Dr. Perrine discusses in detail the characteristics and possibilities of these streams, but this part of his paper need not be reproduced here. He shows in it very clearly the wide distribution of the water power in this territory. Already the development of a few of the available sites has had a powerful influence on the commercial life of the South, and in the contest for industrial supremacy which is continually being waged between sections of our country the ready availability of water power in the South is certain to play no unimportant part. The conditions, it must be observed, are in all respects different from the conditions in other sections of the country. There is no location which can command the field, and within a comparatively short distance of each plant there is another location which may be developed and probably offer competition. The minimum flow is everywhere small and the floods heavy, varying from 75 to 150 times the minimum. But, on the other hand, a class of manufacturers are at hand who appreciate the value of water power even when it is variable, and are accustomed to providing themselves with steam auxiliaries for allowing the use of surplus water power. These conditions are on the whole favorable to the development of water power on a large scale, but point to the necessity for effective management and a comprehensive plan for the development of a section of territory rather than of a single power.

With efficient business management and careful engineering we may expect, he states, the water powers of the Southeastern Appalachian region to prove to be one of the most valuable assets of that wealthy section of our country.

THE HOISTING OF COAL at the anthracite mines in Pennsylvania at speeds as high as from 2,000 to 3,000 ft. per minute is now the usual practice. At Colliery No. 5 of the Lehigh & Wilkesbarre Coal Co., at Wilkesbarre, Pa., 2½-ton car loads of coal are delivered at the surface at the rate of approximately two per minute without interruption, the lift at this point being through a distance of 1,040 ft. The time required per hoist is about 27 seconds, giving thus an average speed of over 38 ft. per second, or at the rate of 2,300 ft. per minute; inasmuch as several seconds' delay occurs in the initial acceleration and final slowing up, so that full speed is not maintained for more than 15 to 20 seconds, it is more than probable that the maximum hoisting speed approaches a mile per minute.

On the Distribution of Shearing Stress in Masonry Dams.

Ever since the publication of Mr. Atcherley's now famous paper on the shearing stresses in masonry dams, the subject has been receiving much attention in British technical journals. Among these discussions none is of more importance than the third of a series contributed to "Engineering" by Prof. W. C. Unwin, which is af follows:,

General Theory.—Let Fig. 1 represent a dam of any shape. Consider a slice of unit thickness as usual. Assuming that the vertical thrust on horizontal sections is a uniformly varying stress, the distribution of thrust on A B will be represented by A D E B; and if forces are taken in masonry units and the same scale used for dimensions and forces, the area A D E B will be equal to the area A H C K B. Similarly, the distribution of thrust on H K will be represented by H F G K, which is equal to H C K. The weight of the layer between A B and H K will be represented to the same scale by A H K B. Consequently, A D M H + K N E B = M F G N.

Take any vertical P S. The resultant vertical force to the right of P S = R S G N — K N E B, and that to the left of P S = A D M H — M F S R, and these two forces are equal but of opposite sign. But either of these represents the resultant of the vertical forces on the part of the layer A H K B, to the right or left of P Q, and therefore the shear on P Q. Hence the intensity of shearing stress at P is approximately either (R S G N — K N E B) P Q or (A D M H — M F S R) P Q. The approximation will be closer the smaller P Q.

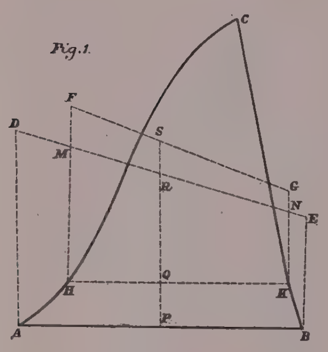


Fig. 1.

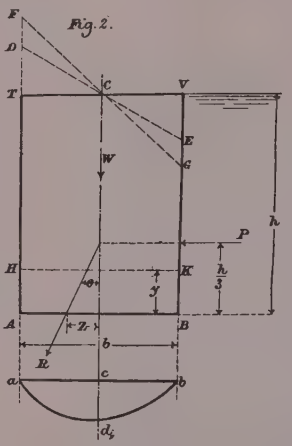


Fig. 2.

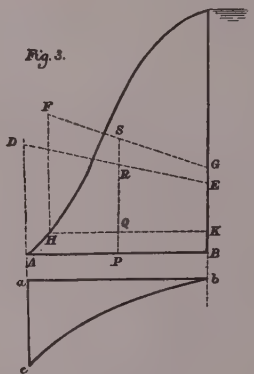


Fig. 3.

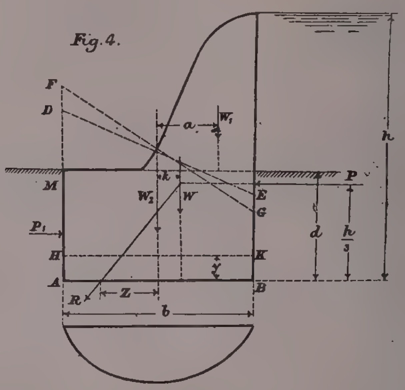


Fig. 4.

Diagrams Showing Distribution of Stresses in Dams.

It will be seen that the variation of shearing stress depends mainly on the relative slope of the lines D E, F G independently of the form of the dam, except so far as that determines the position of the line of resistance, and, therefore, the position and slope of these lines. If, as in the case of a triangular dam with vertical water face, these lines are parallel, the distribution of shearing stress is given by a triangle, as shown in a previous note. In general D E and F G will not be parallel, and then the distribution of shearing stress will be given by a parabola, or a parabola superposed on a triangle.

Case I. Rectangular Dam.—Consider a rectangular dam, with water pressure on one face, Fig. 2. The resultant of the water pressure *P* and the weight of the dam W is R acting at Z from the centre of A B. Let ρ be the density of the masonry relatively to water. Then in masonry units

$$P = \frac{1}{2}\frac{h^2}{\rho} \text{ and } W = b\,h\,.$$

But

$$\tan\theta = \frac{P}{W} = \frac{h}{2\rho b}$$

$$z = \frac{h}{3}\tan\theta = \frac{h^2}{6\rho b}.$$

The vertical thrusts at A and B are given by the equation

$$f = \frac{W}{b}\left(1 \pm \frac{6z}{b}\right) = h\left(1 \pm \frac{h^2}{\rho b^2}\right).$$

The distribution of thrust on A B will be represented by A D E B, and since A D E B = A T V B, the line D E must cross T V at its centre C.

For the section H K, at *y* above A B,

$$f^1 = (h-y)\left\{1 \pm \frac{(h-y)^2}{\rho b^2}\right\}$$

$$f - f^1 = y \pm \frac{h^3 - (h-y)^3}{\rho b^2}.$$

The distribution of thrust on H K will be represented by H F G K, F G also intersecting T V at C, and

$$F\,D = E\,G = \frac{h^3 - (h-y)^3}{\rho b^2} = \frac{3h^2 y}{\rho b^2},$$

when *y* is small.

In this case the area between D E and F G up to any point will vary as the ordinates of a parabola—that is, the shearing stress on A B will be represented by a parabola *a d b*. The middle ordinate of this parabola is the area E C G divided by *y*—that is, when *y* is small,

$$c\,d = \frac{3h^2}{4\rho b}.$$

The total shear on A B is the area of the parabola—that is,

$$\frac{1\,h^2}{2\,\rho}$$

which is equal to P, as it should be.

Case II. Triangular Dam.—This case has been considered in a previous note. The distribution of shearing force is represented by a triangle.

$$\text{The greatest intensity of shear} = a\,c = \frac{h^2}{\rho b}.$$

Case III. Dam with One Vertical and One Curved Face.—In most recent dams the up-stream face is nearly vertical and the down-stream face is curved (Fig. 3). The lines of distribution of thrust on A B and H K—namely, D E, F G—are usually inclined to each other. The total shear on P Q is the area R S G E. The intensity of shear at P is (R S G E) / (P Q) nearly, and this is more exact the smaller P Q is taken. The distribution of shear is represented by a figure *a b c*, consisting of a parabola superposed on a triangle.

Case IV. Dam with Rectangular Base.—It is not uncommon to make the base of such a dam as that in Case III, in the part where the dam is below ground, approximately rectangular (Fig. 4). In any case, the earth resting on the downstream toe virtually forms part of the dam in determining the distribution of shear.

Let W_1 be the weight of the upper part of the dam acting at its mass centre, distant *a* from the centre line of the base. Let $W_2 = b\,d$, in masonry units, be the weight of the rectangular base acting along its centre line. Let P be the water pressure, which in masonry units is equal to $h^2/2\rho$. The position of W, the resultant of W_1 and W_2, is found by the relations

$$W = W_1 + W_2 = W_1 + b\,d;$$

$$W_2\,k = W_1\,(a - k);$$

$$k = \frac{W_1\,a}{W}.$$

The resultant of P and W is inclined to the vertical at an angle θ given by

$$\tan\theta = \frac{P}{W} = \frac{h^2}{2\rho W}.$$

But

$$z + k = \frac{h}{3}\tan\theta.$$

$$z = \frac{h^3}{6\rho W} - \frac{W_1\,a}{W}.$$

The thrust at A and B is given by the equation

$$f = \frac{W}{b}\left\{1 \pm \frac{h^3}{\rho W b} \mp \frac{6W_1 a}{W b}\right\}$$

$$= \frac{W_1 + b\,d}{b} \pm \frac{h^3}{\rho b^2} \mp \frac{6W_1 a}{b^2}.$$

For a section H K at a distance *y* above A, B, *h* — *y* must be substituted for *h* and *d* — *y* for *d*. The thrust on this section at A or B is

$$f^1 = \frac{W_1}{b} + d - y \pm \frac{(h-y)^3}{\rho b^2} \mp \frac{6W_1 a}{b^2}.$$

Hence

$$f - f^1 = y \pm \frac{h^3}{\rho b^2} \mp \frac{(h-y)^3}{\rho b^2}.$$

If D E, F G are the thrust lines for the two sections,

$$D\,F = G\,E = \frac{h^3 - (h - y)^3}{\rho\,b^2},$$

and when y is small,

$$D\,F = G\,E = \frac{3\,h^2\,y}{\rho\,b^2}.$$

Hence the thrust-lines D E and G F intersect at the centre line of the rectangular section, and the distribution of shearing stress on A B is a parabola exactly as in Case I.

It appears, therefore, that in the case of dams with a rectangular base, Mr. Atcherley's assumption of a parabolic distribution of shearing stress would be correct, but not in other cases, such as those discussed in his paper. Further, in actual dams, the approximately rectangular part is below the ground level, and there must in that case be a horizontal thrust P_1 on the face A M, which Mr. Atcherley has omitted in his calculations, and which sensibly reduces the liability to tension on vertical sections near the down-stream toe.

Where the design of a dam is such that there is a sudden change from an approximately triangular to a rectangular or approximately rectangular form, it is impossible to suppose a sudden change in the distribution of the shearing stress. It would appear, therefore, that in the neighborhood of such change of form the distribution of vertical thrust cannot be a uniformly varying one.

Book Notes.

The pamphlet containing the reports on standard cement specifications, uniform methods of tests of cement and uniform methods of cement analysis, which was mentioned in this journal on July 8, can be obtained from Mr. Richard L. Humphrey, 1001 Harrison Building, Philadelphia, secretary of the joint committee of the various societies which have taken part in the work of standardization.

The "Technolexicon," the English, German and French technical dictionary which the Society of German Engineers is compiling, with the assistance of about two thousand firms and individual collaborators in many countries, is progressing satisfactorily. Dr. Hubert Jansen, the editor-in-chief, states that up to the close of June about 2,700,000 word-cards had been collected. To these will be added the hundreds of thousands of cards that will result from the working out of the original contributions not yet taken in hand. Full information concerning this great undertaking can be obtained from Dr. Jansen, whose address is Dorotheenstrasse 49, Berlin.

The "Proceedings" of the tenth annual convention of the National Association of Manufacturers is a book of 320 pages, in which will be found discussions of most of the broad business and manufacturing problems of this country at the present time. The meeting of the association was held only two months ago and the promptness with which its record has been published is commendable. A long review of the book is out of the question, as its contents are too varied. Labor problems, railway transportation, foreign competition and the conditions of trade are discussed by men of national prominence, and the volume is one which will repay careful study by all who depend for their business success on the welfare of our industries. Copies of the book can doubtless be obtained from Mr. Marshall Cushing, secretary of the association, whose offices are at 170 Broadway, New York.

ALTERNATING-CURRENT MACHINERY. By William Esty. Chicago: American School of Correspondence; half morocco, 8vo, 432 pp., $3.75.

Prof. Esty's book is one of the best that has yet appeared for the use of men with a limited theoretical training in higher physics. Consequently it will be of value to a very wide circle of readers who do not care to go into the subject from the advanced standpoint of Mr. Steinmetz's treatises and works of that nature. As a matter of fact the elements of alternating-current machinery can be readily comprehended by anyone who has a good grasp of simple trigonometry, geometry and algebra, and the basic laws of magnetism and electricity. The author has taken unusual care to keep constantly in mind the assumed educational limits of his readers, and the book is consequently well balanced. He uses graphical and geometric methods wherever possible in preference to algebraic, and the "clock" diagram is frequently employed; a large number of examples are employed to show the application of the principles explained in the text to concrete problems.

In the opening articles the reader is made acquainted with the essential features of the source of alternating currents, the alternator, and through it is introduced to the new terms, definitions, and conceptions which form the basis of the subject of alternating currents. Attention is early called to the characteristic features of alternating-current problems which cause them to differ from direct-current problems. A description and discussion of the instruments used in measuring alternating currents, electromotive force and power, follow in natural sequence. The general plan adopted in the subsequent sections, dealing successively with alternators, synchronous motors, transformers, rotary converters and induction motors, is as follows: (a) The physical theory of each class of apparatus is explained; (b) their applications, behavior and operation are discussed; (c) the structural details of commercial types are illustrated; (d) the methods used in making the usual tests and the calculations based on them are explained.

THE PRINCIPAL PROFESSIONAL PAPERS OF DR. J. A. L. WADDELL, C. E. Edited by John Lyle Harrington, C. E. New York: V. H. Hewes, 245 West 107th St. Cloth, large 8vo.

On account of the variety of subjects treated and the large interests aroused by some of these papers at the time of their original publication, attaining sometimes even to antagonism, the undoubted beneficial influences exerted by them both in respect to educational development and to lasting betterment in engineering practice, are potent factors in making this collection very valuable to the beginner and the mature engineer alike. The many excellent addresses upon the absorbing topic of engineering education delivered before a number of engineering societies, universities, colleges, have already in a measure had their reward in substantial improvements along the lines Dr. Waddell therein laid down, and should for years to come be read with no diminution of appreciation by the engineering professor, his students and the technical educator in general.

In regard to engineering practice, the results produced by his papers were more immediate in their effect. At first his theories and methods met with serious opposition among the British engineers in Japan, and later among his professional brethren in the United States; but in the end the soundness of his contentions became scientifically established. That his opinions in regard to such important specialties as bridges, live loads on bridges, elevated railroads, etc., at first met with determined opposition, as well as with high approbation, can be seen in the fact that the book contains writings and views of more than 100 prominent engineers and professors. These opinions have since become fully endorsed by modern practice, and show that, although some of these were advocated several years ago, the paths outlined are still safe to follow. Also noteworthy is the character of the English language employed throughout the work as an imitable example of business and professional English diction; particularly do Dr. Waddell's papers refute the belief that technical scripture furnishes "dry" reading.

THE PURIFICATION OF SEWAGE. By Dr. Sidney Barwise. New York, D. Van Nostrand Co.; cloth, 8vo, 234 pp., $2.50.

Very few analysts have an opportunity to become so familiar with the operation of the various classes of sewage disposal works as the author. As the medical officer of health to the Derbyshire County Council he is required to inspect the operation of all such works in the county, which are of great variety and number. The conditions in England are such that an unusual impetus has been given to the disposal of sewage of late, and as the prejudice against taking out patents by civil engineers does not exist there to any such extent as in the United States, the number of methods that are being promoted commercially is quite large. The author describes these satisfactorily and gives data of their operation in many cases, a considerable portion of the analytical results being furnished by his own laboratory.

The first chapter explains the nature and composition of sewage. The American reader should remember that the lavish use of water in cities on this side of the Atlantic causes a considerable difference between the British and American analyses, and, it might be added here, the difference in climate between Great Britain and most parts of the United States should be considered in any attempt to use Dr. Barwise's data as the basis for American works. The second chapter, on the chemistry of sewage, discusses a subject which it is necessary for the disposal engineer to understand well. The actual analytical work is not at all difficult, and it would seem desirable for most places having large disposal systems to carry on regular analyses, submitting them to some sanitary specialist for comment. This is already being done at water-purifying plants, and its extension to sewage works may save large expenditures in legal controversies over real or alleged nuisances caused by them. The third chapter explains the variation that takes place in sewage, both the diurnal changes and those due to slow flow, sedimentation and bacteriolysis. The fourth chapter is a discussion of river pollution and its effect.

The next four chapters are on the well-known methods of treatment, but are unusually interesting on account of the large amount of data they furnish concerning the actual operation of works. Sewage farming is first taken up; the preparation of land of different characters is explained and the farms at Stratford-on-Avon, Edinburgh, Paris and Berlin are described. The author lays considerable stress on the importance of distinguishing between the utilization and purification of sewage. As a general proposition, he states, agriculturists can get chemical fertilizers in a form in which they can be readily used for less money than the labor costs to apply the sewage in a manner in which it can be absorbed by the crops. The discussion of precipitation, precipitants and tanks is particularly instructive because the author has devoted much personal study to the subject. He has about a dozen tanks of the Dortmund type in his district and two of the Candy type and has thus been able to study on a large scale some of the phenomena of precipitation which are still the subject of dispute. He says that for successful precipitation it is desirable to obtain sewage as fresh as possible, to mix the precipitant very intimately with a small portion of the sewage, and then mix this solution carefully with the whole of it, care being taken to prevent overliming. The discussion of the liquefaction of sewage in septic tanks and contact beds is very clearly prepared. The author's preference is for starting liquefaction in a septic tank and finishing it by means of a lateral bacteria bed kept filled with sewage or by the Adams lateral contact system. The chapter on the principles involved in the oxidation of sewage is likewise particularly well written. He points out that coarse-grain filters worked intermittently effect the largest degree of chemical purification, while the fine-grain continuous filters, although effecting trifling chemical purification, arrest the largest number of bacteria.

The remaining chapters give the most complete description of artificial methods of purification and the various appliances for sewage works, that has yet appeared. The apparatus is not only described, but the results obtained with it are frequently stated, making this section of the book particularly useful to those who wish to become acquainted with British sewage works equipment. The author's opinion concerning future development is as follows: "It is very probable that before long modern views of electricity will bear fruit in this field of labor, and that in the future the action of a biological filter will be intensified by supplying it with ozonized air, or air in which the molecules of oxygen have been rendered less stable by exposure to Roentgen rays, high potential discharges, or the influence of some radio-active substance. For the moment, interest is again centered in the mechanical aeration of percolating filters, the removal of the top layer of sand from which, and the introduction of mechanical distributors, have opened up great possibilities."

The volume closes with instructions concerning the analysis of sewage and sewage affluents; the American reader should study these only in connection with the manual on the subject prepared by the committee on water analysis of the American Public Health Association.

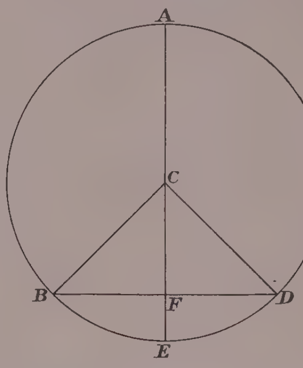
An Unusual Difficulty in Engine Operation.

Engine troubles of an unusual nature are described in the "Electric Journal" by Mr. H. L. Stephenson. This particular engine was a small high-speed, piston-valve type, direct-connected to a 75-kw. lighting machine to be driven at 270 r.p.m. When this outfit was started and the engine given full steam pressure, the first speed would probably be 276, and as quickly as another could be taken, 281, then 287, 293, 297, 301, 310, continuing to creep up slowly. With any load from 10 kw. up, the speed regulation was very good, but whenever the load was thrown off the speed would begin to creep. We ran it throttled until all of its parts had reached an even temperature, but with no better results. The engineman then took out the valve to look for steam leaks, but it seemed to be in good condition. An improvised device showed that the governor did its work, so that it looked reasonable to believe, despite the indicator cards, that there must be some error in the valve setting. This was checked over and the piston was taken out and examined. Cards were taken until there was no more paper to fit the indicator, and so it went for three or four days, until the engineers got hold of the theoretical curve such as engine builders send out as a sort of an advertisement. In comparing the card with one of the no-load curves the trouble was as apparent as though it had been printed in words across the paper. The valve leaked steam. Taking the valve out for the second time the inside of the rings was peened to spread them out, thereby increasing their pressure against the walls of the steam chest. This solved the problem, and the engine now runs perfectly.

Letters to the Editor.

Circular Segments.

Sir: In your issue of May 6, 1905, we find a formula for the approximate solution of the problem relating to the area and circumference of circular segments, but we fail to discover the philosophy of attempting to invent some empirical formula for this purpose, when it is perfectly evident that none can be devised that will apply to all circular segments of varying proportions between the chord and middle ordinate, while the formula given might apply, with a considerable degree of accuracy, to the circle illustrated by the diagram. Of course it would not apply at all to one where the chord is perhaps 100 or maybe 1000 times the length of the middle ordinate, consequently our scheme would be to proceed analytically to the solution of this problem, by first determining the radius of the circle, of which the given segment is a part. We are not aware that this method has ever been published in any engineering hand book, but the writer has been familiar with it for over 50 years, it being original with him.



Our rule, then, for determining the radius of a circle when the chord and middle ordinate are given, reads as follows: Square one half the chord, divide the product by the middle ordinate, then add the middle ordinate to the quotient for the diameter of the circle and divide by 2 for radius.

In the annexed diagram let *C* represent the center of the circle *A B E D*, *BD* the chord and *EF* the middle ordinate. Make *BD* 24 ft. and *EF* 2 ft.; then 24 divided by 2 equals 12, and 12 squared equals 144; 144 divided by 2 equals 72, and 72 plus 2 equals 74, diameter of the circle *AE*; 74 divided by 2 equals 37, radius *CD*.

All the sides of the triangle *BCD* being given, the angle *BCD* is readily determined. This amount being deducted from 360 deg. leaves the length of the circumference of the segment in degrees, minutes and seconds.

The area and circumference of the circle being fixed by the diameter, the area of the sector and the circumference *BED* follows. All the sides of the triangle *BCD* being known, its area is easily determined, and this amount deducted from the area of the sector, leaves area of segment remaining, all complete without any guess work or empirical formulas to differ about.

Our rule for determining the radius of a circle from the chord and versed sine may be very easily reduced to practice by the municipal engineer who is called upon to map streets where the electric car tracks have been installed.

Let two points be fixed with steel tape in the curve of a railway track. Then stretch a strong line or small wire from point to point from the chord, as measured with steel tape. Then measure very carefully the distance from the center of the chord to the rail for the versed sine, and this will be all the data required to fix the curve, assuming that the tangent points have been previously determined; but it is not necessary to measure, for the chord, from one tangent point to the next, as this might involve fractions not convenient to handle, and the chord should be measured by a whole number and divisible by 2, but the middle ordinate will probably be a fraction or a mixed number, a whole number and a decimal, and this distance should be very accurately determined, as the result depends entirely upon the length of this line. Yours truly,

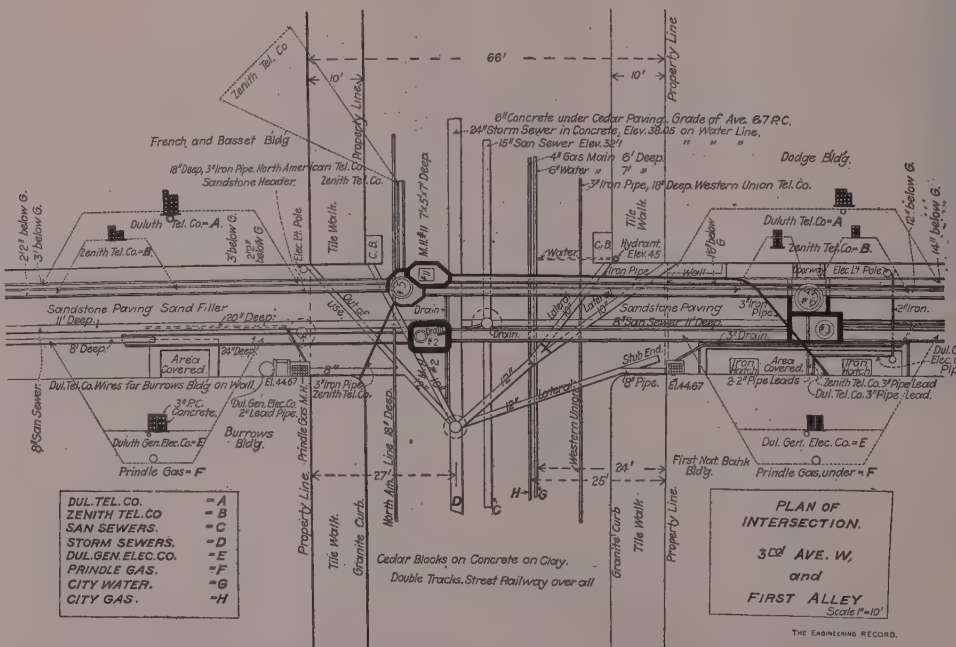
Haverhill, July 7. N. Spofford.

Mapping Underground Work.

Sir: I see by The Engineering Record of March 30 and July 1 that underground mapping is a live subject in other cities than Duluth. This map (see accompanying illustration) is one I compiled, and as it goes deeper into the subject than any I have yet seen published, I herewith present you with a copy. It is the intention to have corrections made at stated intervals on the white prints furnished the companies.

Yours truly, J. C. Bush.

Duluth, July 5.



Map of Underground Conditions at a Duluth Street Intersection.

CURRENT NEWS SUPPLEMENT

JULY 22, 1905.

DIRECTORY OF NATIONAL TECHNICAL AND TRADE SOCIETIES.

American Society of Civil Engineers, Secretary, Chas. Warren Hunt, 220 West 57th St., New York.

American Society of Mechanical Engineers. Secretary, F. R. Hutton, 12 West 31st St., New York.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty St., New York.

National Fire Protection Association. Secretary, W. H. Merrill, Jr., Chicago.

American Institute of Mining Engineers. Secretary, R. W. Raymond, 99 John St., New York.

American Institute of Architects. Secretary, Glenn Brown, Washington, D. C.

Association of Engineering Societies. Secretary Frederick Brooks, 31 Milk Street, Boston, Mass.

American Society of Heating and Ventilating Engineers. Secretary, W. M. Mackay, 235 Water St., New York.

Canadian Society of Civil Engineers. Secretary, Clement H. McLeod, 877 Dorchester St., Montreal.

Society for the Promotion of Engineering Education. Secretary, Prof. M. S. Ketchum, University of Colorado, Boulder, Colo.

American Society for Testing Materials. Secretary, Prof. Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

American Society of Municipal Improvements. Secretary, George W. Tillson, Room 12, Municipal Building, Brooklyn, N. Y. Annual meeting, Sept. 5-9, Montreal.

Association of Railway Superintendents of Bridges and Buildings. Secretary, S. F. Paterson, Concord, N. H.

American Railway Engineering and Maintenance of Way Association. Secretary, L. C. Fritch, 1562 Monadnock Block, Chicago.

American Water-Works Association. Secretary, J. M. Diven, Charleston, S. C.

American Foundrymen's Association. Secretary, Richard Moldenke, P. O. Box 432, New York.

Engine Builders' Association of the United States. Secretary, J. L. Lyle, 39 Cortlandt St., New York.

American Public Works Association. Secretary, W. H. Flint, Chattanooga. Annual meeting, Chattanooga, Aug. 30-31.

Association of American Portland Cement Manufacturers. President, J. B. Lober, 1232 Land Title Building, Philadelphia.

ELECTRICALLY OPERATED REFRIGERATING PLANTS.

Small refrigerating plants are often not installed in places where they are desired simply because of the reluctance to care for a complicated mechanical plant. A way of solving this trouble is suggested in the bulletin of the Edison Electric Illuminating Co., of Boston, as follows:

The only reason which has heretofore prevented central stations from taking up and pushing mechanical refrigeration by the use of electric power has been the lack of automatic devices necessary to regulate the process of refrigeration, so that it shall be carried on only when needed—in the same way that an electric motor pump is now so generally used to keep a tank full by automatically replacing the water used from time to time.

For many years, however, much attention has been given to the invention and design of methods and devices to make refrigerating plants automatic in their operation, and also in the feed of the ammonia and of the water; and it has resulted in the recent development of an Automatic System of Refrigeration which has been demonstrated in practical operation for some months. In this automatic system, using the generally accepted method of ammonia compression, a special and perfected thermostat within the refrigerator absolutely controls the electric motor-driven compressor, so that any desired low temperature may be uniformly maintained in the refrigerating compartment. All the other automatic devices are regulated by the operation of the comperssor itself.

1. The electric motor is stopped and started automatically by the thermostat according to the temperature required in the refrigerating box.

2. The feed of ammonia is automatically controlled by a valve which is regulated by the pressure in the expansion or cooling coils.

3. The feed of cooling water circulating around the condenser pipes and the compressor cylinders is automatically regulated by a valve which is operated by the heat or pressure in the condenser.

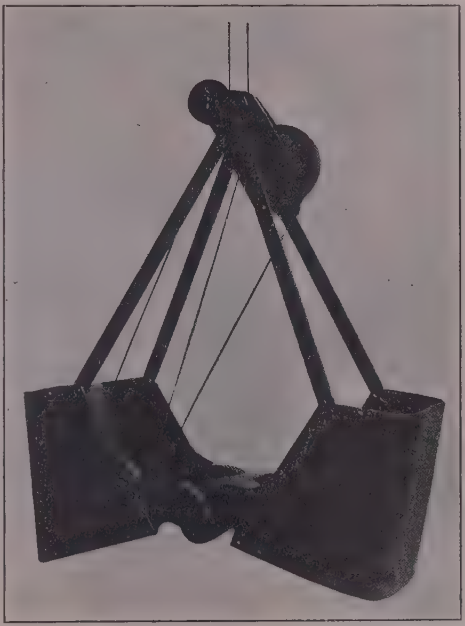
4. The electric motor is also automatically stopped by a high-pressure cut-off when the condenser pressure reaches an excessive limit, and motor again started when this pressure falls to the normal.

During a recent test of nearly 600 hours this perfected thermostat moved so exactly as to automatically stop a motor-driven refrigerating machine more than 1,500 times at the predetermined temperature of 36 deg. Fahr. in a large refrigerating box and again started the machine automatically when the temperature had risen to 38 deg., thus absolutely maintaining the inside temperature within a limit of 2 deg.

Such automatic refrigeration effects a large saving over the cost of ice even if the manifest advantages, as well as cleanliness and convenience of operation, be not considered; and as an example the following figures may be interesting in showing the efficiency of refrigeration by electric power as compared to that of ice. A 3-hp. plant, shown by the accompanying illustration, is capable of producing refrigeration in 24 hours, equivalent to 2,800 pounds of ice in the same time.

Ice in a well-insulated refrigerating space of 400 cubic feet (20x25x8) can maintain a minimum temperature of 45 deg. in hot weather, and will cool about 4,300 pounds of food supplies during the 24 hours.

Equivalent automatic mechanical refrigeration in same space and under like conditions will produce the same temperature of 45 deg., or will produce the usually cold storage temperature of 36 deg., but in a smaller space of about 2,300 cubic feet, and will cool about 4,600 pounds of food supplies per day.



THE FAIVRETTE CLAM SHELL BUCKET.

Electric power for driving refrigerating machines can therefore be used to great advantage for the purpose of cold storage in meat markets, butter shops, dairies, drug stores, restaurants and hotels, and also for many manufacturing purposes where artificial cooling is necessary.

THE FAIVRETTE CLAM SHELL BUCKET.

Last week Mr. Gurdon H. Williams, president of the G. H. Williams Co., 1512 Rockefeller Bldg., Cleveland, was granted a patent on the clamshell bucket shown in the accompanying illustration. Clamshell buckets for excavating or handling bulk material are quite old, the first American patent for them being issued in 1846. Since then a large number of patents for such apparatus has been issued, but mostly for far more complicated designs than that illustrated, which has few working parts and has proved a good digger under adverse conditions on work done by the Great Lakes Towing Co., of Cleveland.

This bucket comprises two scoop members hinged together in the ordinary manner. The hinge section attached to one of the scoop members extends beyond the pivotal connection, forming an arm, in the outer end of which is located a sheave. The outer ends of the scoop members are suspended by bars, the upper ends of which are connected together by means of plates and pins, the plates forming the head and the sheave supports. In this head are located two sheaves.

To the hinge arm at point near its outer end is dead-ended cable which passes around one of the sheaves located in the head, back around the sheave in the arm, up to and under the second sheave in the head of the bucket, this second sheave acting as a guide for the cable only. This cable thus multiplied forms the closing power of the bucket.

To the head of the bucket is attached a second cable which holds the bucket in position while opening, and is used to lower the bucket into the material.

NOTES ON CONCRETE.

In a little manual issued by the Municipal Engineering & Contracting Co., Chicago, for the use of its agents, the following notes are given:

Water.—The old way of mixing concrete was to put in just as little water as would hold the cement-mortar together. This is what is called the "dry" method of mixing concrete. In this method, if a handful of concrete is taken up and squeezed it will retain its shape when the hand is opened; but will not be wet in appearance and will not stain the hand. Such concrete is generally deposited in place and tamped very thoroughly until the excess of moisture is driven to the top and the mass becomes quakey. It is surprising to see how wet concrete will become under thorough tamping when to the eye it looks perfectly dry before being put in place. This method was the only one permitted up to twelve or fifteen years ago by the majority of engineers.

It has been found by careful experiments made in hundreds of places that concrete mixed by this method is much stronger on short time tests than concrete mixed with an excess of moisture. When briquettes, however, are kept one or two years, and then tested, very little, if any, difference in strength can be observed. It therefore seems that when the excess of moisture disappears from the concrete that the strengthening process goes on as it does when the concrete is mixed with just enough water to fulfill the theoretical requirements.

To-day we see the "dry" method used only in places where quick strength is required. That is, where a contractor is working on a time limit and must take his forms down quickly. We also see it extensively used by building block men, for the reason that they must be able to take their blocks quickly from the moulds if they want to avoid a large investment in machinery.

In a wet mix the concrete may be simply a little wetter than a "dry" mix, or it may be so wet that it will run. All contractors who advocate wet mixtures have their preferences for some particular degree of moisture.

The advantage claimed for the wet mixture is that the material will require less tamping and will flow into place, producing a better surface on the face of wall and all exposed surfaces. It is also believed by a great many contractors that there is considerable labor saved when mixing concrete wet, for they say the water distributes the cement throughout the mass better than shovels can do it. Other men dispute this and state that an excess of water simply gives the concrete a well-mixed appearance, without, in fact, improving the mixture. They claim that it is only possible to get a thorough mix by hand by using the "dry" method.

In an extremely wet mixture there is a slight tendency during the setting process for the cement, because of its heavier specific gravity, to settle to the bottom, and this produces a concrete that is not uniform. This is an honest objection to extremely wet concrete.

It has an advantage, however, in this: Reinforced concrete is coming greatly into use. As the metal is placed in the lower part of the structure if there is any tendency of the cement to go to the bottom it is apt to get into the part of the beam where the steel is placed and will there cover the steel in such a manner as to thoroughly protect it. In fact, the great use of steel reinforcement in concrete is largely responsible for the increased favor with which wet mixtures are regarded by workers in concrete.

Dry concrete should be kept moist for at least ten days after it is deposited in place. Cement requires moisture to set it, and if that moisture is not supplied with the mixture, then it must be supplied afterward, so that it is customary to cover all completed structures with wet earth, sand, cloth or other materials that will retain moisture, in such a way that the concrete can absorb the moisture.

When the moisture is supplied with the mixture then the cement, in the process of setting, will absorb the excess. This is the reason that in long time tests concrete mixed very wet shows up as well as concrete mixed dry and kept moist during the process of setting.

Mixtures.—A man starting in the concrete business hears a great deal about the relative strength of mixtures. Some men tell him to use a 1-2-3; others say a 1-2-4 is better; some scoff at these and say that a 1-3-6 is strong enough, while still others will tell about leaner mixtures and the wonderful strength obtained.

Concrete has a compressive strength varying from say 600 pounds to the square inch—such as we see in a great many dry mixed building blocks—to a strength as great as 4,000 pounds to the square inch. The latter strength was obtained with concrete bars made for testing purposes and cured under water. Concrete should have a compressive strength of fully 2,000 pounds to the square inch. The strength of concrete depends entirely upon how well the voids are filled with the cementing medium. Therefore, a lean mixture, thoroughly mixed, will oftentimes attain as great strength as a fatter mixture.

The terms "fat" and "lean" are used among European engineers and scientific men generally to indicate the amount of cement in the concrete. A "fat" mixture varies from one part of cement to one part of sand, to a mixture of one part of cement, two parts of sand and four parts of small broken stone or clean gravel. Any concrete having a smaller proportion of cement is called a "lean" mixture.

In the United States a great many men speak of the fat mixture as being "rich" and the lean mixture as being a "poor" mixture, meaning that one is rich in cement and the other is poor in cement. These terms, however, are not correct when it is considered that a lean mixture, although containing a less amount of cement than a fat mixture, is not a poor mixture. Whether one is as strong as the other in compressive strength depends largely upon the degree of care exercised in distributing the cement-mortar throughout the mass as explained above.

When a man is starting into the work of making concrete and he has no proportion given, but wishes to be as economical as possible in the use of cement, it would be well for him to ascertain the amount of space the neat cement-mortar is to occupy. Fill a box level with stone; shake it slightly so that the voids in the stones will be fairly well reduced; pour into this box, water, carefully measured, until the box is full. This amount of water represents the sand required to fill the voids in the stone. Empty the box and dry it. Lay the stone on a platform when it is dry, or nearly dry, and put over it the amount of sand found necessary to fill the voids; mix the sand and stone together as thoroughly as possible with shovels and refill the box with this mixture. If the stone was dry when the sand was added and the mixing is well done, this sand and stone together should just fill the box. It may take considerable shaking and pouring to get it all in. When the box is full, measure into it as much water as it will hold. This last amount of water determines the amount of cement it will take to fill the voids remaining after the sand has been added. The user can determine for himself the proportions required for all concrete he mixes. If he does not want to go to that trouble he can take it for granted that ordinary bank gravel containing plenty of sand so that none needs to be added, contains about 20 per cent. of voids, although it may contain as high as 30 per cent. It is usual, however, to figure on 20 per cent., and if by actual trial it is found not to be enough, then more cement can be added.

To find the amount of cement required for a cubic yard of bank gravel mixed—say 1 to 8: Add 20 per cent. of the yard to it; this makes a bulk of 32.4 cubic feet; 1-9 of this represents cement, or 3.6 cubic feet. A barrel of cement contains about 3.8 cubic feet of cement, so it will be seen that one cubic yard of ordinary bank gravel will require practically one barrel of cement when mixed 1 to 8.

If this mixture had been one part of cement, three parts of sand and five parts of stone, the procedure would be as follows:

Counting the stone as having 50 per cent. voids, 13.5 cubic feet of sand will fill the voids, but the mixture is 3 to 5, instead of 2½ to 5. Therefore, mixing this concrete on a basis of 27 cubic feet of stone, 3.5 of that represents the amount of sand, or say 16.2 cubic feet. The differenec between 16.2 cubic feet and 13.5 cubic feet equals 2.7 cubic feet, which we have in excess of one yard. This excess must be divided proportionately between the sand and stone. Figuring that there are 8 parts in this excess—5 parts stone and 3 parts sand—divide it in the proportion of ⅝ to ⅜, or say 1.7 cubic feet of stone must be subtracted from the 27 cubic feet of stone, which will leave say then 25.3 cubic feet of stone. One cubic foot of sand will be substracted from the 16.2 cubic feet, leaving 15.2 cubic feet of sand.

Now we must obtain the amount of cement required. The measured cement is to the sand as 1 is to 3, therefore, we take 1-3 of 15.2 cubic feet of sand, or practically 5 cubic feet of cement. As this does not quite fill the voids left in the mass composed of sand, having 50 per cent. of voids, we will consider then that a cubic yard of a 1-3-5 mixture will contain practically 1.2 barrels of cement, 15.5 cubic feet of sand and 25.3 cubic feet of stone.

Another way of figuring this is to take the cubic yard of sand and cement as above ascertained and take one-half the bulk of sand, which will amount to 7.6 cubic feet, as being the amount of voids in the mass. Add this 7.6 to the 27 cubic feet in a yard; divide by 9 (as the cement is 1-9 of the mass), wihch gives practically 3.8 cubic feet of cement, or about one barrel. This means a difference of 20 per cent. in the amount of cement used.

This is not right (although often used) for the voids in the yard really amount to 50 per cent., whereas, here we have taken only the voids in the sand. By counting the voids in the yard at 50 per cent., one-ninth equals 4.5 cubic feet of cement.

The first method is the more correct one for the reason that sand and stone are measured in boxes and the cement is either measured in the bag or barrel, or may be, on some work, measured in boxes.

On a large piece of work it is well to figure in this way, so that when the quantities are measured an excess of cement will be better than if it is found necessary to buy more cement to fill out the mortar. The methods above given will apply to any proportion, but the user must bear in mind at all times that these proportions are based upon an assumption as to the voids in the materials, and it is much better for him to take the material he is going to use and ascertain the voids for himself before making his measuring boxes.

The principal advantage possessed by a fat concrete is that it is more dense than a lean concrete, because of the more perfect filling of the voids with cement-mortar. It is also stronger in tensile strength, although that is not of great importance as a tensile stress is hardly ever put upon concrete; but even a fat concrete may be porous if it is not well mixed, and a lean concrete if thoroughly mixed may be more dense and impervious than a fat concrete. The denseness of concrete governs its compressive strength.

THE LATEST TURBINE ORDER OF THE NEW YORK EDISON CO.

With the successful closing of recent negotiations for two 7500-kw., Westinghouse, turbine-type, generating units the New York Edison Co. has inaugurated another step in metropolitan electric lighting. These units will be installed in the Waterside Station No. 2, which ultimately will contain ten units of the same size. Waterside Station No. 1 is equipped with eleven Westinghouse vertical, three-cylinder, compound reciprocating engines, each rated at about 6,500 h. p. and direct connected to a 3,500-kw. generator. The next step in the acquisition of larger units resulted in the installation of 5,000-kw. turbine units of the Curtis type. In the equipment of the new Waterside station with Westinghouse turbine units of still greater capacity, over twice that of the original engine-type units, there will here exist a striking example of the extremely rapid development in power station construction that has taken place since 1900.

The extreme compactness of the new generating unit is evident by the small space it requires in the new power station arrangement. Its over-all dimensions are, approximately: length 50 ft., width 17 ft., height, 15 ft.; floor space 850 sq. ft. per unit net, or 0.113 sq. ft. per kilowatt capacity. This is less than one-half the space occupied by the engine type units which are the most compact type yet built for central station work. A condenser of the surface type will be located beneath the turbine in the foundations proper.

The new turbines will operate under 175 lb. steam pressure, approximately 28 in. vacuum and 100° superheat, the normal speed of the unit being 750 r.p.m. Under these conditions the economy of the complete unit will be in the neighborhood of 16 lb. per kilowatt-hour at full rated load. Each unit will have an overload capacity of at least 50 per cent. or will be capable of developing full rated load without the use of a condenser. A distinctive feature of this design, the makers point out, is that the turbine gives its best economy around full rated load, although a large overload capacity is at all times instantly available when required without material sacrifice of efficiency. At this maximum load each turbine will be developing over 15,000 h. p. at the shaft, the greatest amount of power ever developed in a single prime mover in stationary service.

The direct-connected turbo-generators will be of standard Westinghouse construction, delivering 6,600 volt, three-phase current to the high-tension network at a frequency of 25 cycles per second. The generators will embody a new enclosed construction which is claimed to constitute an important advantage in the entire elimination of the hum peculiar to high speed turbine generators. They will have an efficiency approximating 97½ per cent. at full rated load. Each generator will be able to sustain for several hours an overload of 50 per cent. within reasonable temperature rise.

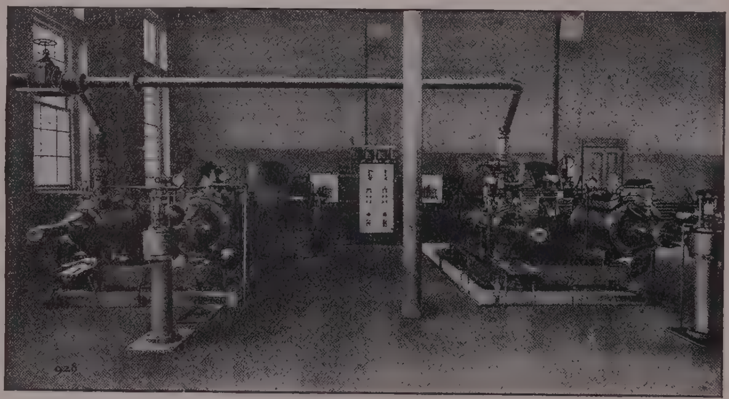
It is of interest in connection with this important installation that almost simultaneously three Westinghouse turbine units of the same size have been adopted by two large Brooklyn power stations, one for railway and the other for lighting service, making a total of over 50,000 h. p. in turbine machinery of this size. Two units will go to the Brooklyn Heights Railway Co. and the third to the Brooklyn Edison Co.

THE ELECTRICAL COMPRESSOR PLANT OF CHICAGO & NORTHWESTERN TERMINAL, CHICAGO.

The air power plant at the terminal of the Chicago & Northwestern in Chicago is located in a small brick building in the rear of the main station, close to the river and adjacent to the extensive passenger yards of the company. This building comprises two rooms, in one of which are the steam boilers for the heating system of the station, and in the other the electrical and pneumatic apparatus.

Alternating current is taken from the city mains of the Chicago Edison Co. and passed through transformers reducing it to the working voltage. Part of it is used directly on low-voltage circuits. The remainder is converted to direct current for power purposes.

The air compressor plant is made up of two Ingersoll-Sergeant standard power-driven compressors, of the type designated by the makers as Class "JC." They are duplex, two-stage machines, with air cylinders, frames and bearings, mounted on a solid cast-iron bedplate which encloses the horizontal intercooler between the cylinders. Both high and low pressure cylinders are fitted with piston inlet valve and regulation is secured by the makers' choking controller on the low-pressure intake. This device, acting to throttle the air intake passage, is controlled by receiver pressure and automatically regulates the volume of air compressed, and consequently the amount of power consumed, to the demand for air from the power system. The compressors run at constant speed, the controller simply varying the effective piston displacement with varying load. The machines have a stroke of 12 in., with air cylinders 12¼ and 18¼ in. in diameter. At their speed of 130 r.p.m. the free air capacity of each unit is 455 cu. ft. per minute. The pressure used in this plant is 70 to 80 lb. gauge.



THE AIR COMPRESSOR PLANT OF THE CHICAGO & NORTHWESTERN R. R. TERMINAL.

The sub-base is extended in each compressor to support the driving motors, which are General Electric, direct-current machines, rated at 80 h.p. and 510 r.p.m., on 220 volts. A pinion on the motor shaft gears directly with the teeth on the compressor flywheel, which is of standard weight for machines of this capacity. The gears are protected by proper guards.

Independent concrete foundations are used. Each unit has its own automatic oiling system on all bearings, fed from a central tank. The drip is recovered and filtered. Sight-feed oilers care for cylinder lubrication. The illustration shows the arrangement of the air plant. The machines are side by side, the switchboard, rheostats, meters, etc., mounted in front of and between them. An intake duct supplying both compressors leads under the floor to the open air and rises beside the power house, terminating in a screen cover for the exclusion of dust and cinders from the yards.

The discharge pipes from the two compressors unite in an air main leading to the primary receiver outside the plant. Provision is made for draining this receiver. From this point, the line leads to a system of cooling tubes to the west of the power house, made up of a large upper and lower horizontal header, connected by a number of small vertical pipes. This arrangement, freely exposed to the air, precipitates whatever moisture may remain in the air after leaving the primary receiver, and this water is withdrawn from the lower header. From this cooler, air lines radiate throughout the yard, supplying power to the pneumatic switch and signal system controlling the movement of trains in the terminal track system. Secondary air receivers are also located at suitable places. The air is used almost entirely in this system of switches and signals, but a small portion is diverted to the boiler room, where it is applied to the terminal.

TEST OF A 2,000 KW., FOUR-STAGE CURTIS TURBINE.

On May 3 Mr. Louis A. Ferguson, second vice-president of the Commonwealth Electric Co., of Chicago, and Mr. Frederick Sargent, of Sargent & Lundy, of the same city, made a test at Schenectady of a 2,000-kw. Curtis turbo-generator running at 900 r.p.m. It is a four-stage machine designed in 1903 and recently changed in a few particulars as the result of experiments conducted during the past year. The unit conforms as nearly as possible to the standard four-stage machines now being made by the General Electric Co.; the builders believe, however, that it is less efficient because it does not contain some important improvements recently made, which could not be introduced without entirely reconstructing it.

RESULTS OF TESTS OF A 2,000-KW., FOUR-STAGE CURTIS TURBINE.

Load	Full.	½	¼	None
Duration, hr.	1.25	0.916	1	1.33
Steam pres., lb., gauge	166.3	170.2	155.5	154.5
Back pres., abs., in merc.	1.49	1.40	1.45	1.85
Superheat, deg. F.	207	120	204	156
Load, kw.	2023.7	1066.7	555	none
Stm. cons., lb. per kw.-hr.	15.02	16.31	18.09	*1510.5

*Steam consumption per hour, lb.

The preparations for the test were made by Messrs. Clark and Eastman, assistants to Messrs. Ferguson and Sargent, who made several preliminary trials furnishing results agreeing closely with those of the official runs. All the instruments were carefully tested and standardized during the trials, the electrical instruments being tested by the New York Testing Laboratory in the presence of Mr. Eastman. The surface condenser showed practically no leakage. The engineers state that they took every precaution to satisfy themselves that the tests were reliable and accurate.

BUSINESS NOTES.

The Dayton Hydraulic Machinery Co. (R. E. Spencer Geare, M. E., sales mgr.) has opened a New York branch office at 133 Liberty St. The company will carry a line of Brooks centrifugal pumps, of which it is the exclusive manufacturer.

Contracts have been awarded to the Ambursen Hydraulic Construction Co., of Boston, for the building of two dams, 320 ft. long by 21 ft. high and 400 ft. long by 13 ft. high, respectively, in northestern Pennsylvania. The development is a private enterprise, and by means of flumes and penstocks the water will be worked off over a head of 950 ft., using Pelton wheels. This is one of the first high-head propositions in the East.

Mr. H. B. Jewkes, who for the last four years has been interested in and manager of the rail business of Hyde Bros. & Co., has severed his connection with that firm and has organized the Iron City Steel Company, with offices in the Bessemer Building, Pittsburg, Pa.

The Riverside Bridge Company, Wheeling, W. Va., has closed contracts for all the steel bridge and viaduct work on a new line in course of construction in West Virginia. The company also has a number of other large contracts for mill buildings and bridges for some of the largest railroads in the United States.

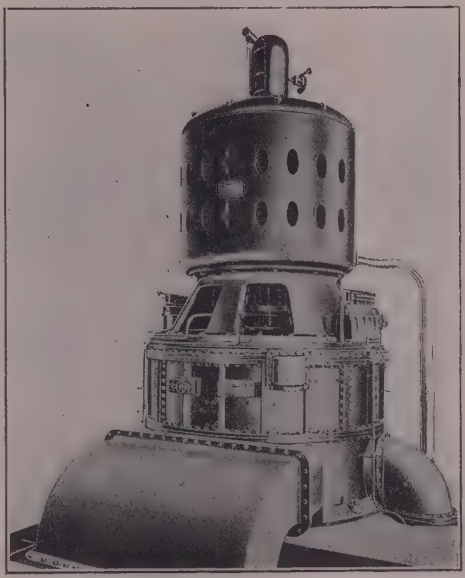
G. M. Gest, of New York and Cincinnati, subway contractor, has been awarded a contract for the construction of a complete underground conduit system at Washington, D. C., for the Western Union Telegraph Co. This conduit system will be constructed of a specially made steel pipe instead of clay and will connect all of the Western Union Telegraph Co.'s offices as well as the department buildings in and around Washington. Work is to begin by August 1, and several hundred men will be employed.

The use of the electrolytic process for the treating of ores is constantly increasing. An indication of this is shown by an order just placed with the Crocker-Wheeler Co., of Ampere, N. J., through its New York branch. The order calls for two size 898, Crocker-Wheeler, engine-type, direct-current generators, with a capacity of 10,000 amperes and 105 volts. These will be special machines with 22 poles. The speed will be 100 r.p.m. They will be installed at Carteret, N. J., in a plant where there are at present four Crocker-Wheeler generators of varying capacity up to 750 kilowatts.

The American Street Railway Manufacturers' Association has secured the South Pavilion of the Philadelphia Museum and a larger adjoining building for the exhibits at the convention of the American Street Railway Association in Philadelphia on Sept. 25-30. They have about 75,000 sq. ft. of well-lighted floor space and are reached by a switch from the Pennsylvania R. R. Ample facilities for outdoor exhibits are also provided, with 1,000 ft. of track and connections for electric service.

The Electro-Dynamic Co., Bayonne, N. J., is enlarging the scope of operation for the Inter-pole motor, and within three months will be prepared to sell at least 200 varieties of constant and variable speed motors running as high as 150 hp. in capacity. At the International Electrical Exhibition just held at Mechanics Hall, Boston, the company showed motors covering 123 distinct varieties. These ranged from 1 to 10 hp. in rating, with a 1 to 4 speed range, and one of them was connected up so that its remarkable properties could be tested by those interested.

Alexander Knox, Times Bldg., New York, is introducing in this country a window balance used for private and public buildings in Australia, where it was invented, and in Great Britain. It was originally designed for a frame building where, for some reason, there was not enough room for the ordinary sash-weights. The device is described in the "Builder" of London as follows: The method of hanging the sashes is simple and ingenious. A metal bar is centrally pivoted on each frame jamb, the pivot being, approximately, at the middle of the height of the window. One end of each bar is attached to the upper sash, and the other end to the lower sash. Projecting pins are fixed to the outer sides of the sash-stiles, the two for the lower sash being near the bottom rail, and those for the upper near the top rail. These pins slide in grooves in the jambs of the frame. When the sashes are closed, the pivoted bars are in a vertical position, but when the lower sash is raised they gradually revolve until a horizontal position is attained, forcing the meeting rails apart, and at the same time, drawing the upper sash down to the same extent as the lower sash is raised from the sill. The inner sides of the stud grooves are also made to take out, so that the sashes can be turned over for cleaning. The sashes are easily fixed and operated, and do not rattle. They are also said to be thoroughly water-tight.



FOUR-STAGE CURTIS TURBO-GENERATOR.

PERSONAL NOTES.

Mr. A. L. Kuehn has been appointed assistant chief engineer of the Big Four line, with offices at Indianapolis.

Mr. John O'Conner, formerly a shipbuilder and government contractor, died July 13 at his home in Buffalo, N. Y.

Mr. Arthur M. Burtt has been appointed supervising architect of the Isthmian Canal Commission, with offices at Ancon, Canal Zone.

Mr. Walter P. Moore has been elected superintendent of streets in San Diego, Cal., to succeed Mr. S. W. Hackett, who has resigned.

Mr. E. M. Merriweather has been appointed engineer of maintenance of way on the Western and St. Louis divisions of the Wabash R. R., with offices at Moberly, Mo.

Mr. C. W. Raynor has opened a consulting engineering office in Room 407, Jackson Blk., Denver, Colo., and will make a specialty of city and country bridges for highway traffic.

Mr. F. G. Jonah has been appointed to the office of assistant engineer of the Frisco terminal at Chalmette and will be succeeded by Mr. C. H. Fisk as terminal engineer of the New Orleans Terminal Co.

Mr. Jackson Smith, assistant to Mr. J. G. Metcalf, first vice-president of the Mexico National R. R., has been appointed assistant to Mr. John F. Stevens, chief engineer of the Isthmian Canal Commission.

Mr. Robert McDowell has been appointed superintendent of highways and sewers at Altoona, Pa., and that department and the department of surveys have been merged in the department of public works, Mr. Andrew Kipple, chairman.

Mr. E. W. Kennedy, formerly professor of civil engineering in University College, England, and Mr. J. Clifton Robinson, who has done much in promoting electric railways in London, have been knighted for their services.

Mr. George F. Syme has been appointed resident engineer of the South & Western Ry., with headquarters at Spruce Pine, N. C. He has lately been connected with the Coke & Coal Ry. at Delta, W. Va., in the same capacity.

Mr. Herbert Findlay, of Warsaw, Ind., was re-elected president, and Mr. Cortez Knight, of Marion, Ind., was re-elected secretary of the Surveyors and Drainage Commissioners' Association of Indiana at its recent convention at Winona Lake, Ind.

Prof. Chas. G. Hyde, professor of sanitary engineering in the civil engineering department of the University of California, has gone to Berkeley, Cal., after spending nearly a year investigating municipal sanitation in various cities of the country.

Mr. G. W. Vaughn, engineer of the western division of the New York Central & Hudson River R. R., has become chief engineer of maintenance of way on that road, succeeding Mr. A. T. Hardin, who has been appointed assistant general manager. Mr. D. L. Summerville succeeds Mr. Vaughn.

Major Villiers Sankey and two engineers of the Grand Trunk-Pacific R. R., Messrs. Hill and Beauchamp, were drowned July 11 in Manitou Lake, twenty-five miles north of Kenora, Man. The party was locating a new railroad and the accidental drowning was due to the upsetting of a canoe.

Mr. Cecil B. Smith, consulting engineer and chairman of the Temiskaming & Northern Ontario Ry., has been appointed engineer of the Hydro-Electric Power Commission which has been appointed by the government of Ontario to inquire into electrical power production and water-power development in that province.

The New York State Civil Service Commission will hold examinations Aug. 19 for the following positions: Architectural designer, architectural draftsman, assistant civil engineer and civil engineering draftsman. The examinations are open to residents and non-residents, and further particulars may be obtained from the chief examiner of the commission at Albany, N. Y.

Mr. P. H. Irwin, assistant chief engineer of the Baltimore & Ohio R. R., has been appointed consulting engineer of that road, succeeding the late Mr. David Lee. Mr. John E. Greiner, engineer of bridges and buildings, has been appointed assistant chief engineer, succeeding Mr. Irwin, but will continue his duties as engineer of bridges and buildings.

Major Lansing H. Beach, Corps of Engineers, U. S. A., has been relieved of river and harbor duty at Detroit, Mich., and ordered to Fort Leavenworth, Kan., for duty as an instructor in engineering in the Infantry and Cavalry School and General Staff College, relieving Major Thomas H. Rees, Corps of Engineers, U. S. A. Col. Garrett J. Lydecker, Corps of Engineers, U. S. A., has been temporarily placed in charge of the engineering works at Detroit in addition to his present duties as division engineer.

Mr. William H. Nazro, of Dorchester, Mass., has been appointed welfare manager of the National Civic Federation and will sail for Panama July 20 with Mr. T. P. Shonts, member of the Isthmian Canal Commission, and Mr. John F. Stevens, chief engineer of the Commission, to investigate the welfare conditions in the canal zone and then make recommendations to the Commission how these conditions may be improved. He will be assisted by Mr. E. A. Moffatt.

Mr. E. A. Handy, chief engineer of the Lake Shore & Michigan Southern R. R., has been appointed assistant general manager of that road and will be succeeded in his present position by Mr. Samuel Rockwell, now assistant chief engineer. Mr. G. C. Cleveland, assistant chief engineer of the Lake Erie & Western R. R., succeeds Mr. Rockwell, and Mr. G. P. Smith, engineer of maintenance of way on the Illinois, Indiana & Iowa R. R., at Kankakee, Ill., has been promoted to Mr. Cleveland's position.

Mr. A. H. Whiteside, manager of the district office of the Allis-Chalmers Co., at Atlanta, Ga., has become manager of the Philadelphia district office of that company, succeeding Mr. W. A. Wood, who has resigned. Mr. M. W. Thomas has been appointed manager of the district office at Atlanta. Mr. W. J. Buckley has been made manager of district office of the company at St. Louis, Mo., succeeding Mr. H. P. Hill, who has gone to the Salt Lake City, Utah, district office and will devote his time to the electrical features of the company's business.

CONTRACTING NEWS

OF SPECIAL INTEREST TO
CONTRACTORS, BUILDERS, ENGINEERS AND MANUFACTURERS
OF ENGINEERING AND BUILDING SUPPLIES.

WATER.

Notes Arranged Alphabetically by States.

Ocean Park, Cal.—The Venice Water Co. is reported incorporated with a capital of $250,000 by J. D. Pope, Thornton Kinney and others, all of Ocean Park.

Boulder, Colo.—M. B. Tomblin, of Boulder, writes that it is proposed to construct a dam and reservoir for irrigation purposes to cost about $82,000. This is a private enterprise. Engineers, Wilson & Fair.

Montrose, Colo.—Plans and specifications are on file at the office of The Engineering Record, 114 Liberty St., New York, N. Y., for the construction of about 8 miles of distributing canal for distribution of water from mouth of Gunnison tunnel, bids to be received until Aug. 28, at the office of the Engineer, U. S. Reclamation Service, Montrose, as advertised in The Engineering Record.

Longmont, Colo.—Bids will be received by the Blue Mountain Reservoir & Ditch Co., Longmont, on Aug. 1 for building Blue Mountain reservoir dam, as advertised in The Engineering Record.

Washington, D. C.—The following are the bids opened on June 29 by Lieut. Col. Smith S. Leach, Corps Engrs., U. S. A., for furnishing material (except Portland cement) and constructing 29 concrete steel sand bins for Washington Aqueduct filtration plant: The R. J. Beall Constr. Co., Washington, $73,075; Tucker & Vinton, New York, N. Y., $96,230; The Bunting Constr. Co., New York, N. Y., $64,300; Rudolph S. Blome Co., Chicago, Ill., $48,838; The Brennan Constr. Co., Washington, $55,100; The Sand Filtration Corp. of America, Washington, $56,342, and Bell Eng. & Constr. Co., New York, N. Y., $67,496.

Washington, D. C.—See "Power Plants, Gas and Electricity."

Ft. McPherson, Ga.—Bids will be received by Capt. B. B. Buck, Q. M., Ft. McPherson, until Aug. 15 for furnishing material and constructing reservoir, pumphouse, etc., as advertised in The Engineering Record.

Ft. Gaines, Ga.—See "Power Plants, Gas and Electricity."

Mascoutah, Ill.—It is stated that bids will be received until Aug. 3 by the City Council for constructing water works consisting of steel storage tank on steel tower, furnishing and laying 5,000 ft. 6 to 8-in. c. i. water pipe with valves, specials, hydrants, and furnishing and erecting gasoline engine and pumps. Harper Bros., Engrs., East St. Louis, Ill.; C. J. Lischer, City Clk.

Chicago, Ill.—Bids will probably be called for in about 2 weeks for reconstructing the city water tunnels in the down town district. John Ericson, City Engr.

Tama, Ill.—H. J. Ferguson, City Clk., writes that the contract for improving the water works, including power house, pumping machinery, etc. (bids opened July 11) has been awarded to Des Moines Bridge & Iron Works, of Des Moines, for $7,995.

Markle, Ind.—J. X. Walker, Town Clk., writes that at the election July 12, the question of issuing bonds for waterworks was defeated.

Crawfordsville, Ind.—See "Power Plants, Gas and Electricity."

**Sioux City, Ia.*—Chas Poth is reported to have secured the contract for constructing the new city pumping station for $5,900.

Charles City, Ia.—The City Council is reported to have decided to construct a reservoir with a capacity of 300,000 gal. to cost about $5,000.

Garnett, Kan.—Bids are wanted July 27 for water works improvements. Engineers, Burns & McDonnell, Dwight Bldg., Kansas City, Mo.

Sabetha, Kan.—Burns & McDonnell, Dwight Bldg., Kansas City, Mo., are preparing plans for water works and a sewerage system for Sabetha.

Hammond, La.—Bids will be received until Aug. 8 by the Mayor and Bd. of Aldermen for constructing a system of water works. C. H. Jenks, Engr., Fayette, Miss.; address Jas. B. Adams, Town Clk.

New Orleans, La.—The Sewerage and Water Bd. is reported to have under consideration the construction of a 12-in. water main on the river front, from Louisiana Ave. to Clouet St., at a cost, with other work, of $50,000.

The Sewerage and Water Bd. is stated to have on July 13 authorized Geo. G. Earl, Supt., to select three additional engineers to assist him in the preparation of plans for a water purification plant.

South Framingham, Mass.—At a special town meeting July 10 the citizens are reported to have voted to extend the water works of the Framingham Water Co., employ an engineer and appropriate $50,000 by an issue of bonds.

Ft. Revere, Hull, Mass.—Bids will be received until Aug. 9 by Maj. John E. Baxter, Q. M., U. S. A., Boston, Mass., for furnishing material and making extensions and improvements to the post water supply and furnishing and installing a Worthington steam pump all at Ft. Revere.

Grand Rapids, Mich.—Bids will be received by the Bd. of Pub. Wks. until Aug. 11 for constructing a standpipe or elevated tank of concrete-steel or steel, 80 ft. high and 50 ft. diam., as advertised in The Engineering Record.

Manistique Mich.—The lowest bids opened on June 22 by the Bd. of Pub. Wks. for constructing water works and a sewerage system is reported to have been submitted by Green & Co., of Appleton, Wis., for about $125,000.

Barnesville, Minn.—It is stated that bids will be received until Aug. 5 by M. P. Philippi, City Clk., for furnishing material and constructing water works, consisting of 2 driven wells, power house, machinery setting, etc., a 60-in.x16-ft. return flue tubular boiler, 2 compound duplex pumps and boiler feed pump, about 5¾ miles of water pipe with hydrants, valves, etc. ,a standpipe or an elevated steel tank and tower. M. A. Earl, Engr., 1416 First Natl. Bank Bldg., Chicago, Ill.

Boonville, Mo.—Bids are wanted July 25 for water works improvements. Engineers, Burns & McDonnell, Dwight Bldg., Kansas City.

Farmington, Mo.—See '"Power Plans, Gas and Electricity."

Arlington, Neb.—B. F. Hadley, Village Clk., writes that the proposed water works will cost about $13,100. Engineer, M. A. Earl, 1416 First Natl. Bank Bldg., Chicago, Ill.

Lyndhurst, N. J.—Bids will be received until Aug. 14 by the Township Com. at Lyndhurst for laying c. i. water pipe and appurtenances in Union Township, as advertised in The Engineering Record.

New York, N. Y.—The following are the bids opened July 12 by John T. Oakley, Comr. Water Supply, Gas and Electricity, for hauling and laying water mains in Bassford, Cypress and other streets: Pease Bros., Flushing, L. I., $9,074; Wilton Constr. Co., 115 Elliott Ave., Williamsbridge, $7,022; John Cornwell, 69 E. 127th St., $7,281; Louis D. Gregory, $6,297; P. Goodman, 1668 Park Ave., $8,425, and Gallo & Pettelli, 127 Mulberry St., $6,636.

Oneida, N. Y.—Bids will be received by the Bd. of Pub. Wks. until Aug. 8 for the construction of a dam, pipe line connection, grubbing, clearing and fencing land, etc., as advertised in The Engineering Record.

Buffalo, N. Y.—The following are reported to be the lowest bids opened on July 14 by the Dept. of Pub. Wks. for improving the pumping station at Massachusetts Ave.: Steel and iron work, Kellogg Iron Wks., $39,840; roofing, Machwirth Bros. Co., $24,353; masonry and cut stone, B. I. Crooker, $118,940; plumbing, C. A. Cri-

Newton, N. C.—Eugene E. Gaddis, of Washington, representing the Interstate Water Works & Constr. Co., is stated to have presented a proposition to the Town Comrs. in which the company proposes constructing and operating a system for 10 years, at the end of which time the town may acquire the water works.

Elyria, O.—Bids will be received by the Bd. of Pub. Service, July 31, for furnishing and erecting water wks. machinery, as advertised in The Engineering Record.

Lakewood, O.—Bids will be received until July 25 for $2,750 bonds, issued for the purpose of laying water main on Mathews Ave. and also for $5,850 bonds issued for the purpose of laying water main in a portion of Sloane Ave. Henry J. Sensel, Village Clk.

Leesburg, O.—It is proposed to construct water works here. Engineer, G. L. McKibben, Van Wert, O.

Lorain, O.—Separate bids will be received until July 27 by the Bd. Pub. Service (H. Y. Baxter, Pres.) for furnishing the following: 90 tons 12-in., 405 tons 6-in. and 12 tons 4-in. c. i. water pipe, 30 tons specials, consistting of Ts, Ys, reducers, bends, etc.; 75 hydrants, 175 6-in. gate valves and five 12-in. gate valves.

Cincinnati, O.—Bids will be received until Aug. 8 by the Bd. Trus. Comrs. of Water Wks. (Aug. Herrmann, Pres.), for laying c. i. pipe and special castings and valves in portions of Ludlow, Dodsworth and Hamilton Aves., in all aggregating about 4,470 lin. ft. of 20-in. c. i. pipe.

*The city of Cincinnati has awarded to J. S. Jackson, representing the California Asphaltum Sales Agency, Whitehall Bldg., New York, N. Y., the contract for waterproofing work on the reservoir at a cost of about $268,000. The work is to be done with California material.

Plymouth, O.—See "Power Plants, Gas and Electricity."

Ashland, Pa.—Bids will be received by the Boro. Council until Aug. 1 for additions to water distributing system, as advertised in The Engineering Record.

Dover, Pa.—The citizens are reported to have voted July 12 to issue $11,000 bonds for water works.

Philadelphia, Pa.—New bids are about to be asked by A. Lincoln Acker, Dir. Dept. Pub. Wks., for sand to be used in the Torresdale filters.

West Lebanon, Pa.—It is reported that between $15,000 and $25,000 will be expended for a public water supply.

Laurens, S. C.—Bids will be received until July 25 for making improvements to the water works, including 2 electrically driven centrifugal pumps of 300 gals. per minute capacity; filtration plant, 450,000 gal. capacity; furnishing a mile of c. i. pipe, building clear water basin, laying pipe, etc. For further information address J. L. Ludlow, Engr., Winston, N. C.

Madison, S. D.—It is stated that bids will be received until Aug. 3 by the City Council for furnishing and laying about 2,000 ft. 4½-in. water mains and 4 hydrants. Wm. Rae, City Aud.

Morristown, Tenn.—It is reported that about $45,000 will be expended for the construction of water works.

Ogden, Utah.—The Ogden Water Works Co. is reported to have under consideration the construction of a reservoir for the storage of water for irrigating purposes and the construction of an electric power plant.

St. Johnsbury, Vt.—C. B. Weeks, Village Clk., writes in regard to procuring a new water supply that nothing will be done for the present.

Casper, Wyo.—Bids will be received at the office of the Superv. Engr., U. S. Reclamation Service, Denver, Colo., on Aug. 16 for the construction of the Pathfinder dam and auxiliary works, to impound flow of North Platte River, as advertised in The Engineering Record.

Cody, Wyo.—Plans and specifications are on file at the office of The Engineering Record, 114 Liberty St., New York, N. Y., for the construction of the Shoshone dam, spillway, outlet and road tunnels, requiring about 69,000 cu. yds. concrete masonry and 75,000 cu. yds. excav. located 8 miles west of Cody, bids for which are to be received until Sept. 5 at the office of the U. S. Reclamation Service, Billings, Mont., as advertised in The Engineering Record.

**Calgary, Alta, Can.*—F. W. Thorold, City Engr., writes that Irish & Grant, of Calgary, have secured the contract for laying c. i. water pipe, setting valves and hydrants (bids opened June 7) for $5,120.

Winnipeg, Man.—Bids will be received until July 31 by J. C. Gibson, Chmn. Fire, Water and Light Com. for a supply of brass goods, etc., as advertised in The Engineering Record.

Gananoque, Ont.—The Town Clk. writes that it was voted July 6 to issue $35,000 bonds for the completion of the water works and sewerage system.

SEWERAGE AND SEWAGE DISPOSAL.

Notes Arranged Alphabetically by States.

West End, Ala.—Sewer bonds to the amount of $15,000 are reported to have been sold on July 13.

Gainesville, Fla.—Wm. W. Lyon, of Palatka, Fla., has been engaged to prepare plans and supervise the construction of a sewerage system, to cost about $50,000.

**Rock Falls, Ill.*—W. M. Dearborn, of Stone City, Ia., is stated to have secured the contract for constructing a sewerage system for Rock Falls, at $15,401.

East St. Louis, Ill.—See "Paving and Roadmaking."

**Columbus, Ind.*—Stillinger & Lee, of Columbus, are stated to have secured the contract for constructing the 9th St. sewer for $9,092.

Mooresville, Ind.—The Town Bd. is stated to have decided to establish a sewerage system.

Angola, Ind.—A. C. Wood, Town Clk., writes that whether a sewerage system will be constructed or commenced this year, is still uncertain. Nothing definite has been decided upon.

Franklin, Ind.—Otis B. Sellers, City Engr., writes that bids opened July 11 for the construction of sanitary sewers, have been rejected, all being too high. A new estimate will be prepared and new bids received.

**Duluth, Minn.*—The following are the bids opened on July 7 by the Light and Water Comrs. for constructing a 10,000,000 gal. reservoir, including one valve chamber (bidders of Duluth unless otherwise mentioned): (*a*) Smith & Vokes; (*b*) W. D. Lovell; (*c*) A. G. Osman; (*d*) Lang & Preston; (*e*) Thomas & McCoy; (*f*) Geo. R. King; (*g*) Patrick McDonnell (awarded contract):

	a	*b*	*c*	*d*	*e*	*f*	*g**
54,000 cu. yds. earth excav	$0.40	$0.14	$0.50	$0.40	$0.50	$0.35	$0.36
150 cu. yds. rock excav	3.75	5.00	3.00	2.00	2.00	2.00	3.00
2,000 cu. yds. Portland concrete, 6-in. thick	5.50	3.78	6.00	5.25	5.00	6.25	4.00
750 cu. yds. crushed rock, 6-in. thick	3.00	2.25	3.50	2.25	2.00	1.75	1.50
3,300 sq. yds. sandstone pavement, grouted	2.40	2.75	2.60	2.50	2.50	2.00	1.75
3,000 cu. yds. puddle	2.00	1.30	.50	.20	.25	.65	.40
1,164 lin. ft. Sandstone coping, 30x9 in	2.50	2.18	2.20	2.00	2.00	1.90	1.00
600 lin. ft. rough stone gutter	1.00	.75	.40	.60	.25	1.25	.40
Total	$53,467	$38,495	$55,707	$45,985	$52,908	$46,114	$37,739

New York, N. Y.—Bids were opened on July 12 by John T. Oakley, Comr. Water Supply, Gas and Electricity, for furnishing, delivering and laying water mains in numerous streets in Manhattan and Bronx Boroughs. The following are the totals of bids, including connections and 253 hydrants and 400 6-in. stop cocks, etc.; also unit prices on some of the other items: (bidders of Manhattan Boro. unless otherwise mentioned): (*a*) Pease Bros., Flushing, N. Y., $146,920; (*b*) Wilton Constr. Co., 115 Elliott Ave., Williamsbridge, $123,155; (*c*) John Cornwell Jr., 69 E. 127th St., $127,492; (*d*) Louis D. Gregory, $123,365; (*e*) Clinton Beckwith, 27th St., near 6th Ave., $136,790; (*f*) Cunningham & Kearns, 438 E. 91st St., $135,098; (*g*) Burns & Rodgers, 1909 Amsterdam Ave., $125,686, and (*h*) Patk. Goodman, 1668 Park Ave., $133,653.

	a	*b*	*c*	*d*	*e*	*f*	*g*	*h*
1,640 tons straight pipe	$27.75	$27.50	$26.00	$29.00	$26.50	$28.00	$29.00	$29.60
70 tons specials	58.00	56.00	65.00	65.00	60.00	62.00	62.00	60.00
3,450 cu. yds. rock without blasting	3.50	.32	2.40	2.50	1.00	.30	.30	3.50
450 cu. yds. masonry excav	2.00	.32	1.50	.01	1.00	1.00	.30	3.50
36,350 cu. yds. earth excav	.30	.32	.30	.25	.44	.30	.30	.25
40,800 cu. yds. fill	.20	.32	.15	.20	.22	.30	.30	.25
12,650 12-in. pipe to lay	.35	.35	.38	.35	.35	.32	.30	.35
59,300 6-in. pipe to lay	.16	.25	.16	.12	.20	.16	.15	.20
10 cu. yds. brick masonry	17.00	.01	17.00	.01	15.00	10.00	12.00	15.00
10 cu. yds. concrete masonry	7.50	3.00	6.00	.01	7.50	10.00	10.00	10.00
1,800 sq. yds. asphalt pavt	5.00	.01	4.25	3.00	3.50	4.00	4.00	4.00
800 sq. yds. granite block	2.00	.01	1.25	.01	2.00	1.50	.90	1.50
1,200 sq. yds. pavt., flagging, etc	.50	.01	.40	.01	2.00	.50	.10	.50
1,400 sq. yds. macadam	.50	.35	.50	.01	.50	.50	..	.50
2,600 lin. ft. curb and gutter	.12	.01	.01	.01	.10	.10	.10	.01
80 lin. ft. 6-in. boxing	1.00	3.50	6.00	8.00	5.00	6.00	4.00	6.00

**Items marked thus give the names of parties awarded contracts.*

Centerville, Ia.—It is proposed to construct new sewers and about 3 miles of brick paving. Estella Gordon, City Clk. M. G. Hall, City Engr.

Sabetha, Kan.—See "Water."

Ossawatomie, Kan.—Burns & McDonnell, Dwight Bldg., Kansas City, Mo., have completed plans for the proposed sewerage system.

McPherson, Kan.—W. J. Krehbiel, Mayor, writes that it is proposed to construct a sewerage system, but nothing has been done so far except to make a preliminary survey.

Georgetown, Ky.—Bids will be received about Aug. 1 by the City Council for $25,000 bonds issued for the purpose of constructing a sewerage system. J. W. Kellar, Mayor.

**Westfield, Mass.*—The following are the bids opened July 17 for building Sections 10 and 11 of the storm water sewer: Dan. A. Dorey & Co., Somerville, $6,500 (awarded contract); Henry Spinach, Naugatuck, Conn., $7,213; Edw. B. Roberts, Boston, $7,446; Geo. R. Newman, Providence, R. I., $7,685; C. E. Trumbull Co., Boston, $8,139.

Grand Rapids, Mich.—Bids will be received by the Bd. of Pub. Wks. until Aug. 11 for constructing a concrete steel, concrete or brick sewer, along line of West Side Ditch, as advertised in The Engineering Record.

Manistique, Mich.—See "Water."

Greenville, Mich.—The Riggs & Sherman Co., of Toledo, O., is preparing plans for a separate system of pipe sewers for Greenville, only a small portion will be constructed this season.

Wyandotte, Mich.—Bids will be received until Aug. 2 by the Bd. Pub. Wks. (H. O. Maloch, Secy.) for installing a completed system of brick, vitrified and cement pipe sewers. Mason L. Brown & Co., Engrs., 821 Chamber of Commerce, Detroit.

**Marshall, Minn.*—John R. Gray, City Recorder writes that the contract for about 2,699 ft. 15 and 10-in. sewers (bids opened July 8) has been awarded to Ilstrup & Olson, of Minneapolis, for $2,098.

Windom, Minn.—Bids will be received until Aug. 1 by J. E. Jenness, Village Recorder, for constructing sewers in several streets. Loweth & Wolff, Engrs., First Natl. Bank Bldg., St. Paul.

Kansas City, Mo.—The Bd. of Pub. Wks. is stated to have directed the city engineer to prepare plans and procure bids for the construction of a storm sewer from 15th St. and Indiana Ave., to care for the water south from 8th St. and north from 27th St.; estimated cost of work $69,000.

**East Syracuse, N. Y.*—C. T. Hookway, of Syracuse, is stated to have secured the contract for the completion of the sewerage system from the receiving well to the disposal plant for $16,000.

West Haverstraw, N. Y.—Bids will be received on Aug. 5 by Rev. H. C. Potter, Pres. Bd. Mgrs. State Hospital for Care of Crippled and Deformed Children, at West Haverstraw, for sewers and connections, as advertised in The Engineering Record.

White Plains, N. Y.—The Bronx Valley Sewer Comn. (Wm. Archer, Chmn., Mt. Vernon) is stated to have voted to issue $7,000 bonds for preliminary work on the proposed sewer to be constructed from White Plains to Yonkers to empty into Hudson River; probable cost of proposed work is $2,000,000. Engineer, Geo. R. Byrne, of White Plains.

**Binghamton, N. Y.*—M. J. Herrick & Co., of Binghamton, are stated to have on July 7 secured the contract for constructing the 5th Ward trunk sewer, for $16,279.

**Scotia, N. Y.*—Jas. A. Hoyt, Jr., Village Clk., writes that the contract for sewers (bids opened June 22) has been awarded to De Nallo & Klingburg, of Kingston, for $12,317.

Press reports state that bids will be received until July 27 for the construction of a sewage disposal plant. J. A. Hoyt, Village Clk. Engineer, L. B. Sebring, Parker Bldg., Schenectady.

Mamaroneck, N. Y.—The following are the bids opened July 12 by the Village Trus. for constructing about 4 miles of sewers (Engineer, John M. Farley, White Plains). The bids were submitted in three different sections as follows: (*a*) Sect. 1, (*b*) Sect. 2, (*c*) Sect. 3, (*d*) grand total: M.Decicco & Co., Larchmont, *a* $22,113, *b* $10,456, *c* $19,245, *d* $51,815; Harrison Constr. Co., Newark, N. J., *a* $26,866, *b* $11,132, *c* $20,491, *d* $58,490; Alex. S. Traub, N. Y. City, *a* $28,480, *b* $13,128, *c* $20,584, *d* $62,192; Bellew & Merritt, Tuckahoe, *a* $63,975, *b* $17,060, *c* $40,234, *d* $121,297; Abbott, Gamble Co., N. Y. City, *a* $67,189; Pasquale Cestone, Montclair, N. J., *c* $23,586.

Wilmington, N. C.—The Brooklyn Sewerage Co., of Wilmington, is reported incorporated with a capital of $25,000 by J. H. Hehder, Geo. H. Heyer, Jesse Wilder and H. L. Fentress.

Massillon, O.—Harold Howard City Engr., writes that bids will probably be received about Aug. 3 for constructing pipe sewers in numerous streets.

Steubenville, O.—F. S. King, City Aud., writes that bids are wanted for the construction of sewers on Adams and Logan Sts., to cost about $35,000. S. B. Curfman, City Engr.

Norwood, O.—Bids will be received until Aug. 12 by the Bd. Pub. Service (E. R. Edwards, Clk.) for furnishing material and constructing a sanitary sewer in Main Dist. No. 3.

**Columbus, O.*—The Bd. of Pub. Service is stated to have on July 12 awarded to A. F. Helm the contract for constructing the Eldon Ave. storm sewer, for $15,945.

Chagrin Falls, O.—It is reported that a preliminary survey is about to be made for a sanitary sewerage system.

**London, O.*—Jos. Murphy, of Marion, is stated to have on July 10 secured the contract for constructing a sanitary sewerage system and disposal works for London, at $47,153.

Elyria, O.—East Ave. sewer bonds amounting to $14,500 have been sold.

Cincinnati, O.—Bids will be received until Aug. 14 by the Bd. Pub. Service (Geo. F. Holmes, Clk.) for furnishing material and improving a portion of Kinney Ave. by constructing sewers and drains.

Dayton, O.—Bids will be received until July 27 by Wm. F. Miller, Clk. Bd. Pub. Service, for constructing storm water sewers on Coate Ave. and First St., also on same date for constructing sanitary lateral sewers in part of Dist. Nos. 9 and 5, both advertised in The Engineering Record.

Wellston, O.—It is stated that bids will be received until July 25 by the Bd. Pub. Service (Jas. O. Dorsey, Clk.) for furnishing material and constructing certain sewers.

Philadelphia, Pa.—Local press reports state that the Philadelphia Rapid Transit Co. will construct a sewer in Market St., east of City Hall, in connection with the construction of the eastern section of Market St. subway. W. S. Twining, Ch. Engr., 820 Dauphin St.,

Tacoma, Wash.—Several sewer districts have been ordered, aggregating about 10 miles, mostly 8-in. terra cotta pipe. Frank L. Davis, City Engr.

Merrill, Wis.—Bids will be received until July 25 by the Bd. Pub. Wks. for furnishing material and constructing sewers in portions of Cottage, W. 4th and State Sts., requiring 3,652 ft. 10, 12, 15 and 16-in. salt glazed vitrified sewer, 8 circular brick manholes, 21 circular brick catchbasins and 90 6-in. Y house connections. F. E. Mathews, city engr.

**Milwaukee, Wis.*—The contract for building 1,809 ft. brick sewer and 127 ft. of iron sewer in 2d and Center Sts., is stated to have been awarded on July 12 to G. E. Zimmermann for $15,392.

Gananoque, Ont.—See "Water."

BRIDGES.

Notes Arranged Alphabetically by States.

**Weaverville, Cal.*—R. C. Carter, Co. Clk., writes that the contract for constructing a bridge over Trinity River (bids opened July 6) has been awarded to Cotton Bros. & Co., of Oakland, for $6,189.

Hollywood, Cal.—See "Paving and Roadmaking."

Sacramento, Cal.—The Bd. of Supervisors is stated to have instructed the surveyor to prepare plans and specifications for a concrete bridge over Buffalo Creek; approximate cost, $30,000.

Merced, Cal.—It is stated that bids will be received until Aug. 8 by the Bd. Superv. for constructing bridges on the Merced and Dos Palos Road.

Bridgeport, Conn.—Bids will be received by E. T. Buckingham, City Clk., Bridgeport, until Aug. 10 for the construction of a reinforced concrete arch bridge over Ash Creek bet. Bridgeport and Fairfield, as advertised in The Engineering Record.

Frankfort, Ind.—It is stated that bids will be received until Aug. 7 by the Co. Comrs. for constructing a number of concrete arches and repairing certain bridges throughout the county. E. O. Burget, Co. Aud.

**Ft. Wayne, Ind.*—The Canton Bridge Co., of Canton, O., is stated to have received the contract for constructing a steel bridge over St. Mary's River, for $5,110.

Portland, Me.—The following bids are reported to have been opened on July 8 by the Bridge Comn. for constructing Vaughans Bridge; *a*, steel structure; *b*, pile structure: American Bridge Co., of New York, N. Y., 3 bids, $370,000 to $376,700; New England Structural Co., of Boston, Mass., *a* $450,000; Boston Bridge Works, of Boston, Mass., *a* $480,000; Augustus Smith, of New York City, *a* (2 bids) $355,530 and $366,765, *b* (2 bids) $229,032 and $242,150, (*a* and *b*) (2 bids) $326,464 and $335,058; Holbrook, Cabot & Roberts, *b* $253,000; Mt. Vernon Bridge Co., Columbus, O., *a* $333,000; P. E. Lane, of Atlantic City, N. J., *a* $368,000, *b* $135,000; New Jersey Bridge Co., N. Y. City, *a* $339,555.

**Benton, Me.*—The contract for constructing a steel bridge 255 ft. in length over Sebasticook River is stated to have been awarded to the New England Construction Co., of East Everett, Mass., for $10,540.

Boston, Mass.—It is stated that bids will be received until July 27 by Wm. Jackson, City Engr., for constructing piers and abutments for Northern Ave. Bridge and for concrete and wooden flooring, roadway paving and curbing and stone coping of the Atlantic Ave. Bridge.

**Muir, Mich.*—E. S. Fuller, of Lyons, Deputy Township Clk., writes that the contract for construction of a bridge at Muir (bids opened June 26) has been awarded to Slater Constr. Co., of Pontiac, for $11,340.

Mt. Clemens, Mich.—It is reported that bids, including plans and specifications, will be received until Aug. 7 by Wm. F. Kracht, City Clk., for constructing a 2-span reinforced concrete bridge, total length 195 ft., and to carry two 40-ton cars. The roadway is to be 50 ft. wide with 10 ft. sidewalks or 40 ft. wide with 8 ft. side-

Clarksdale, Miss.—Bids will be received until Aug. 7 by the Bd. Superv. for constructing a steel bridge across Sunflower River at Clarksdale. Alex. M. Searles, Engr., Vicksburg, Miss.

Virginia City, Mont.—It is reported that bids will be received until Sept. 8 by the Bd. Co. Comrs. at Virginia City for constructing 2 steel bridges across Big Hole River, 7 miles from Twin Bridges.

Billings, Mont.—The citizens of Yellowstone County are stated to have voted to construct a bridge at Junction and one at Huntley, to cost $35,000 and $40,000 respectively.

Somerville, N. J.—It is stated that bids will be received by the Bd. Chosen Freeholders for constructing Bridge St. bridge in Somerville.

Hackensack, N. J.—It is stated that bids will be received until July 26 by the Bd. Chosen Freeholders for constructing the Jay St. Bridge at Tenafly.

It is stated that bids will be received until July 24 for constructing the bridge at Park Ave., Park Ridge. G. N. Ackerman, Chmn. Bd. Chosen Freeholders, Hackensack.

Montvale, N. J.—It is stated that bids will be received until July 26 by the Bd. Chosen Freeholders at Hackensack (G. N. Ackerman, Chmn.), for constructing a bridge at Upper Montvale.

**Paterson, N. J.*—The Bd. Freeholders of Bergen and Passaic Counties are stated to have awarded the contract for completing 3-span, plate-girder bridge over Passaic River to Dean, Schweirs & Sutton for $8,258.

**New Brunswick, N. J.*—Dean, Schwiers & Sutton are stated to have received the contract for constructing a highway bridge at Milltown for $8,932.

New York, N. Y.—The Bd. of Estimate is stated to have on July 14 adopted the plans of John F. Ahearn, Pres. Manhattan Boro., providing terminal facilities at the Manhattan end of Williamsburg Bridge; probable cost of terminal, including work of reconstructing elevated tracks on bridge, will be about $1,000,000.

Bids will be received until Aug. 10 by Geo. E. Best, Comr. of Bridges, for furnishing the metal work for the anchorages and constructing the towers, cables, suspenders and suspended superstructure of the Manhattan Bridge between the Boroughs of Manhattan and Brooklyn.

Poughkeepsie, N. Y.—Work is about to be started on the reinforcement of the Poughkeepsie Bridge for the purpose of enabling the structure to withstand the large increase in traffic and tonnage contemplated by the New York, New Haven & Hartford R. R. Operations at the bridge site will be started in a short time, and it is expected that the entire work will be completed within 16 to 18 months, at a cost in the vicinity of $1,500,000. The American Bridge Co., of New York, has been awarded the contract for the completed work on the metallic structure. The reinforcement will be executed under the supervision of Mace Moulton, consulting engineer, 150 Nassau St., New York, retained by the railroad company to investigate the conditions and formulate an adequate scheme for reinforcement.

Troy, N. Y.—Bids will be received until July 28 by the Bd. Contract and Supply (Jas. M. Riley, Clk.) for constructing the abutments and wing walls of the Winter St. Bridge across Wynantskill River, also for constructing steel superstructure for same.

Fargo, N. D.—It is stated that bids will be received until Aug. 8 by the Co. Comrs. for constructing 3 small bridges in the county. Arthur G. Lewis, Co. Aud.

Springfield, O.—Local press reports state that bids will be received by the City Clk. until about Aug. 3 for constructing an iron bridge across Buck Creek at Water St., to cost about $10,000.

Cleveland, O.—The following are the bids opened on July 14 by the Bd. of Pub. Service for a concrete steel arch under the W. & L. E. Ry. in Brookside Park: Beers & Doolittle, Citizens Bldg., $19,195; Jas. Duff & Co., $23,834; J. B. Freuenthal and G. H. Bramley, $21,644; Block Bridge & Constr. Co., $24,063; Williams Bros. & Morse, $23,927; J. W. Norton, $26,768; Clements Bros. Constr. Co., $26,728; Concrete Steel Constr. Co., $25,698; Northern Ohio Pav. & Constr. Co., $26,732.

Marion, O.—Bids, including plans and specifications, will be received until Aug. 7 by the Co. Comrs. for constructing the steel superstructure of a bridge across Scioto River, about 3 miles north of Prospect, to consist of one span 188 ft. long, 16 ft. roadway, the cost estimated, including a complete floor system, at $10,500. Bids will also be received on same date for constructing the substructure of said bridge, consisting of solid concrete monolithic abutments and wing walls, estimated to contain about 400 cu. yds. L. M. Hipsher, Co. Aud.

Kittanning, Pa.—Bids will be received until July 28 by the Co. Comrs. for constructing a bridge 55 ft. long and 12 ft. wide across Plum Creek, in Cowanshannock Township, near Boro. of Atwood. Benj. Oswald, Co. Clk.

West Chester, Pa.—It is stated that bids will be received until July 26 by the Co. Comrs. for constructing a 2-arch stone bridge across Marsh Creek in Upper Uwchlan Township. N. R. Rambo, Co. Surv.

Graham, Tex.—J. W. Akin, Co. Judge, writes that bids will be received until July 25 for constructing 2 steel bridges over Brazos River in Young County; probable cost, $40,000. Engineer, Wilmer Waldo, Houston.

**Wenatchee, Wash.*—The County Comrs. are stated to have awarded the contract for constructing a bridge over Wenatchee River at Cashmere to the International Constr. Co., of Seattle, for $5,400.

PAVING AND ROADMAKING.

Notes Arranged Alphabetically by States.

Hollywood, Cal.—The citizens are stated to have voted to issue $15,000 bonds for street improvements and constructing bridges.

Denver, Colo.—It is stated that bids will be received until Aug. 1 by F. W. Jaycox, State Engr., for constructing a wagon road about 25 miles long.

Macon, Ga.—An election will probably soon be held to vote on issuing $75,000 bonds for paving.

Lincoln, Ill.—Bids will be received until July 25 by the Bd. Local Improvements (E. G. King, Chmn.) for grading, guttering and curbing with cement concrete and paving with brick paving block equal to Poston Block on a 6-in. Portland cement concrete foundation on a portion of College Ave. and S. Logan and E. Pekin Sts. Jas. C. Greenslate, City Clk.

Chicago, Ill.—Bids will be received until July 26 by the Bd. Local Improv. (Andrew M. Lynch, Pres.), for paving with brick, asphalt and limestone on portions of several streets.

**Items marked thus give the names of parties awarded contracts.*

**Kewanee, Ill.*—Engr. Chas. F. Sturtevant, of Kewanee, writes that the contract for cement and brick walks on certain streets (bids opened June 26) has been awarded to Reiff & Kleinemier, of Kewanee, for $15,000.

East St. Louis, Ill.—Plans are being prepared for grading, sewering and paving with brick on 6-in. concrete 15th, 10th and 9th Sts. W. J. Crocker, City Engr.

Greensburg, Ind.—It is reported that bids will be received until Aug. 7 by the Co. Comrs. for constructing about 11,500 ft. of macadamized road in Clay Township. Frank E. Ryan, Co. Aud.

Crownpoint, Ind.—W. L. Allman, County Aud., writes that all bids opened July 15 for constructing 3 miles of gravel road in Center Township have been rejected and new bids will be received Aug. 15.

**Vernon, Ind.*—Phineas B. Ewan, Chmn. Co. Comrs., writes that the contract for constructing 2 miles pike road in Spencer Township (bids opened July 3) has been awarded to Hudson & Baker, of Hayden, for $4,223.

Tipton, Ind.—It is stated that bids will be received until July 31 by John C. Ludlow, Supt. of Constr., at the office of Clifford & Clifford, Tipton, for constructing a gravel road.

Delphi, Ind.—Local press reports state that bids will be received about July 25 by the City Council for paving with Warren's bitulithic pavement, in all about 13,720 sq. yds., at an estimated cost of $31,000.

Knox, Ind.—It is reported that bids will be received by the Co. Comrs. until Aug. 8 for constructing 6 gravel roads, in all about 117,953 ft. L. M. Ransbottom, Co. Aud.

Corydon, Ind.—It is reported that bids will be received until Aug. 8 by the Co. Comrs. for constructing about 9 miles of gravel road.

Logansport, Ind.—Bids will be received until Aug. 8 by the Co. Comrs. for constructing a gravel road in Jackson Township, Cass County. O. C. Gard, Co. Aud.

Vincennes, Ind.—Bids will be received until Aug. 8 by the Co. Comrs. for constructing 6,555 ft. of gravel road in Johnson Township, Knox County. John T. Scott, Co. Aud.

**Sioux City, Ia.*—The contract for paving with asphaltum about 3,700 yds. on Jones and 5th Sts. (bids opened July 11) has been awarded to the Barber Asphalt Paving Co., of Des Moines, at $2.03 per sq. yd.

**Clarinda, Ia.*—Engr. Wm. Christie, Jr., of Red Oak, writes that the following are the bids opened on July 14 for paving: (*a*) 10,380 sq. yds. brick paving on 4-in. concrete foundation, (*b*) 6,955 ft. curb. concrete 5x22-in., (*c*) totals: Dunnegan & Carey, Shenandoah, *a* $1.71, *b* 35 cts., *c* $20,683 (awarded contract); Harrigan, Iowa City, *a* $1.74, *b* 38 cts., *c* $21,463; J. C. Likes, Des Moines, *a* $1.84, *b* 33 cts., *c* $22,045; Evan J. Evans, Red Oak, *a* $1.76, *b* 35 cts., *c* $21,463. A. W. Stewart, City Clk.

Centerville, Ia.—See "Sewerage and Sewage Disposal."

New Orleans, La.—The Finance Com. is stated to have, on July 12, opened bids as follows for paving a portion of Dufossat St.: Barber Asphalt Paving Co., Hennen Bldg., $2.25 per sq. yd., and Louisiana Improv. Co., Hennen Bldg., $2.35 per sq. yd.

**Warren, Mass.*—O. T. Benedict, of Pittsfield, is stated to have received the contract for constructing 5,400 ft. of State highway between Warren and West Brookfield, for $5,331.

Boston, Mass.—See "Bridges."

**Boston, Mass.*—J. M. McCarthy, Clk. State Highway Comn., writes that contracts for building sections of State highway (bids opened July 13) have been awarded as follows: To O. T. Benedict, of Pittsfield, for 9,500 ft. in Great Barrington for $2,800; to E. J. Rourke, of Abington, for 2,600 ft. in Abington for $2,343, and to J. E. Watkins, of Amesbury, for 3,800 ft. in Newbury for $4,378.

The following are the bids opened July 15 by the Bureau of Yards and Docks, Navy Dept., Washington, D. C., for brick paving and concrete sidewalk at Navy Yard, Boston: (*a*) brick paving on Pier No. 1 complete, (*b*) for all work complete according to plans: T. H. Gill & Co., 88 Broad St., Boston, *a* $15,245, *b* $23,265; Coleman Bros., 15 Court St., Boston, *a* $17,400, *b* $24,795; C. M. Leach Boston, *a* $15,408, *b* $23,783; Soule, Dillingham & Co., 19 Exchange Pl., Boston, *a* $17,678, *b* $26,701; Jas. Doherty, 133 Calumet St., Boston, *a* $13,656, *b* $21,349; Jas. C. McGuire & Co., 26 Cortlandt St., New York, N. Y., *b* $24,839.

**Taunton, Mass.*—The Warren Bros. Co., of Boston, has secured the contract for paving the City Hall Square, City Square and Bway., with bitulithic, for about $30,000.

Lansing, Mich.—The following are the bids opened on July 17 for paving Washington Ave.: S. Champion, $7,583; W. H. McKale, $7,854; M. E. Fitzpatrick, $7,974; Green & Redman, $9,600, and J. H. Algate, $10,564.

St. Paul, Minn.—It is sated that Rice St. will be macadamized at a cost of $6,863.

Bayonne, N. J.—Bids will be received until Aug. 1 by the Mayor and Bd. of Aldermen for paving on W. 26th St. with asphalt, including curbing, etc., in all about 5,500 sq. yds., as advertised in The Engineering Record.

**Freehold, N. J.*—The Bd. of Chosen Freeholders is stated to have awarded on July 12 the contract for constructing first section of the Allentown and New Egypt stone road to C. R. Le Compte and Jas. H. Butcher, of

**Harrison, N. J.*—Van Kuren & Son, of Harrison, are stated to have received the contract for paving with bitulithic a portion of Worthington Ave., for $17,011.

New York, N. Y.—The following are the bids opened July 12 by Louis F. Haffen, Pres. Bronx Boro., for repaving with granite block on a concrete foundation E. 149th St., from 3d to Morris Ave.: (*a*) F. V. Smith Constr. Co., $40,142; (*b*) Cunningham & Kearns, $32,860.

	a	*b*
2,900 lin. ft. new curb	$0.90	$0.85
400 sq. ft. new bridge stone	.60	.60
9,325 sq. yds. granite block pavem't	2.90	2.44
250 lin. ft. old stone block pavem't	.40	.01
1,700 cu. yds. concrete	5.50	4.00
10,000 sq. yds. old flagging	.04	.04
100 sq. yds. asphalt pavem't	4.00	2.00

New York, N. Y.—The following are the bids opened on July 12 by Louis F. Haffen, Pres. Bronx Boro., for regulating, etc., Teller Ave., from E. 164th St. to E. 107th St.: (*a*) Uvalde Asphalt Paving Co., $34,605; (*b*) P. J. Kane, $48,939; (*c*) P. J. Dufty, $44,996; (*d*) T. Crimmins Contr. Co., $36,035; (*e*) D. W. Moran, $36,792; (*f*) F. V. Smith Contr. Co., $53,554; (*g*) F. Del Balso, $38,138.

	a	*b*	*c*	*d*	*e*	*f*	*g*
10,800 cu. yds. earth excav	$0.55	$0.65	$1.00	$0.52	$1.05	$0.60	$0.75
9,000 cu. yds. rock excav	1.60	1.75	1.90	1.50	1.06	1.60	1.75
44,860 cu. yds. filling	..	.25	.05	.01	..	.40	..
7,110 lin. ft. new curb	.75	.80	.80	.91	.85	.80	.75
28,440 sq. ft. new flag	.25	.27	.26	.29	.29	.25	.25
1,720 sq. ft. new bridge stone	.50	.60	.50	.59	.62	.60	.55
450 cu. yds dry rubble masonry	2.00	1.00	2.00	1.50	1.00	2.00	2.00
21 M. ft. lumber	30.00	50.00	5.00	30.00	50.00	..	..

**Seattle, Wash.*—Bids opened on July 8 by the Bd. of Pub. Wks. for paving Pike St., from 7th to Boylston Ave., with brick, asphalt and sandstone block; the following are the totals of bids received, also unit prices of some of the principal items (bidders all of Seattle): (*a*) Bell & Price, $59,919; (*b*) Stirrat & Goetz, 602 Bailey Bldg., $59,416 (awarded contract); (*c*) Jas. Markey, $62,281, and (*d*) Sparger Concrete Co., $61,353.

	a	**b*	*c*	*d*
Clearing and grubbing (lump sum)	$1,000.00	$500.00	$800.00	$800.00
5,000 cu. yds. sub-grading	.40	.40	.55	.45
4,500 lin. ft. curb, straight granite	1.25	1.30	1.32	1.45
570 lin. ft. curb, curved granite	1.30	2.00	1.60	1.70
3,140 sq. yds. brick pavement	2.70	2.40	2.42	2.60
6,150 sq. yds. sandstone pavement	3.05	3.20	3.25	3.25
2,270 sq. yds. asphalt pavement	2.15	2.00	1.90	2.10
670 sq. yds. brick gutters	2.70	2.40	2.45	2.65
330 sq. yds. alley crossings, brick	2.70	2.40	2.65	2.65
275 cu. yds. concrete bulkhead (retaining wall)	8.50	8.00	9.00	7.00
26,000 lbs. steel (a) high	.03½	.04	.05	.03½
50,000 lbs. steel (b) mild	.03½	.04	.05	.03
15 catchbasins to be moved	40.00	35.00	25.00	20.00
29 inlets to be moved	7.00	5.00	5.00	5.50
2,390 lin. ft. 12-in. c.-i. pipe	2.10	2.10	2.38	2.30
580 lin. ft. 8-in. c.-i. pipe	1.30	1.35	1.50	1.40

**New York, N. Y.*—The following contracts are stated to have been awarded by John F. Ahearn, Pres. Manhattan Boro. (bids opened June 30) for regulating and repaving with wood block on concrete foundation: Eppinger & Russell, 66 Broad St., portion of Chambers St., for $31,383; United States Wood Preserving Co., 29 Bway, portions Barclay, Duane, Greenwich Sts. and E. Bway for $175,325; also W. Tenth St. at $2.70 per sq. yd.; Franklin Contr. Co., 1 Hudson St., portions Vesey and Reade Sts., for $61,955; also portions of Jefferson and Liberty Sts., at $2.50 per sq. yd. For list of bids received for this work see issue of The Engineering Record July 8.

The following are the lowest bids opened July 12 by Louis F. Haffen, Pres. Bronx Boro., for regulating, grading, setting curb, flagging, etc.: 169th St., from Clay Ave. to Grand Boule.: G. L. Brown, $32,374; 139th St., C. F. McCabe, $21,694; Jennings St., F. Del Balso, $9,453; Findley and College Aves. and E. 166th St., T. Crimmins Contr. Co., $18,190; E. 140th St., D. W. Moran, $13,912; Bailey Ave., C. W. Collins, $10,090, and the Uvalde Asphalt Co. submitted the lowest on Morris Ave., $13,449; Parkside Pl., $11,562; E. 180th St., $16,928, and E. 196th St., $21,999.

The only bid received and opened on July 12 by Louis F. Haffen, Pres. Bronx Boro., for constructing approaches to bridge over N. Y. & H. R. R. at Webster Ave. and 222d St., was submitted by J. J. Hart Co. for $9,828.

The following bids were opened same time and place for granite block paving on E. 151st St., from Mott Ave. to River Ave.: D. W. Moran, $8,389. W. J. Fitzgerald, $8,065; Cunningham & Kearns, $8,120; J. H. Devlin, $12,027; Helbock & Son, $7,798; M. Baird Cont. Co., $9,123.

Bids were opened same time and place for paving Stebbins Ave., from Dawson St. to Westchester Ave., with asphalt blocks: Barber Asphalt Paving Co., $6,544; Continental Asphalt Paving Co., $6,991; Asphalt Constr. Co., $7,434; Hastings Paving Co., $6,782.

New York, N. Y.—The following are the bids opened July 12 by Louis F. Haffen, Pres. Bronx Boro., for repaving with asphalt block on concrete foundation, Boston Road, from Prospect Ave. to Southern Boule.: (*a*) Continental Asphalt Paving Co., $46,160; (*b*) Barber Asphalt Paving Co., $41,239; (*c*) Hastings Pavement Co., $42,653; (*d*) Asphalt Constr. Co., $44,917.

	a	*b*	*c*	*d*
20,200 sq. yds. asphalt blk pavm't	$1.55	$1.36	$1.39	$1.46
2,850 cu. yds. concrete	4.00	3.75	4.00	4.30
3,000 lin ft. new curb	.90	.81	.85	.79
2,500 lin. ft. old curb	.30	.26	.25	.32

**Brooklyn, N. Y.*—The following are the bids opened on July 19 by Martin W. Littleton, Pres. Brooklyn Boro. for regulating and paving with asphalt on concrete foundation Bedford Ave. from Malbone St. to Flatbush Ave. (*a*) 43,070 sq. yds. asphalt, (*b*) 5,980 cu. yds. concrete, (*c*) totals: Brooklyn Alcatraz Co., 12th St. and Gowanus Canal, Brooklyn, *a* 74 cts., *b* $4.10, *c* $56,390 (awarded contract); Uvalde Co., New York, *a* 74 cts., *b* $4.20, *c* 56,988; Cranford Co., Brooklyn, *a* 75 cts., *b* $4.20, *c* $57,418; Barber Co., New York, *a* $1.07, *b* $3.79, *c* $68,749.

*Robertson & Gerehart, 77th St. and 3rd Ave., Brooklyn, have secured the contract for regulating, curbing, guttering and laying sidewalks on 81st St. from 11th to 13th Ave. at the following detail bid opened on July 19: 658 sq. yds. brick gutters on concrete foundation, $2.30; 2,960 lin. ft. new curb, set in concrete, $1.12; 30,161 cu. yds. earth excav., 28 cts.; 14,670 sq. ft. cement sidewalk, 15 cts.; total, $15,474. The other bids received were: Mangieri Co., New York, $17,490; T. J. Farrell, $18,680; Norton & Gorman, $19,535; Vofrie & O'Hearn, $15,543; Donlin Contr. Co., $18,875, and N. Schneider's Sons, $15,985. Bidders of Brooklyn unless otherwise mentioned

Oneonta, N. Y.—O. A. Miller, Village Engr., writes in regard to bids opened July 18 that T. C. Willard Co., New York, bid for 8,500 sq. yds. clay block, 99.6 cts. per sq. yd.; the Northampton Portland Cement Co., Stockerton, Pa., bid for 1,500 bbls. Portland cement, $1.20 per bbl.; Daley & Smith, of Cobbleskill, N. Y., bid for 1,500 cu. yds. crushed limestone, $1.13 per cu. yd.; Ingalls Stone Co., Binghamton, bid for 3,000 ft. bluestone curb., 4x16 in., 38 cts. per lin. ft., and for 1,000 cu. yds. sand $1.20 per cu. yd. There were 26 bids for furnishing brick, the lowest bid being 78 cts. per yd.

Buffalo, N. Y.—Bids will be received Aug. 1 by the Dept. Pub. Wks. (Francis G. Ward, Comr.) for paving stone, crosswalk stone, curbing, sand, gravel and crushed stone for street repairs for the fiscal year 1905 and 1906.

**Wellsville, N. Y.*—F. M. Leonard, City Clk., writes that the contract for paving N. Main, Depot, E. Fassett and E. State Sts. with brick, 3,600 sq. yds. pavement and 7,000 lin. ft. curb (bids opened June 26) has been awarded to R. W. Herron, of Geneva. Du Bois repressed block will be used.

Johnstown, N. Y.—Bids will probably be received about Aug. 21 for paving 4 blocks with asphalt; probable cost, $27,000. F. Byaskel, City Clk. J. F. Campbell, City Engr.

**Rochester, N. Y.*—Whitmore, Rauber & Vincinus, 279 South Ave., are stated to have received the contract for paving with asphalt Park Ave. with brick between car tracks for $37,838.

Auburn, N. Y.—It is stated that bids will be received until Aug. 8 for 13,400 sq. yds. of asphalt, bitulithic or brick paving. J. W. Ackerman, City Engr.

Kingston, N. C.—Bids will be received until Jul 31 by the Bd. of Aldermen for furnishing material and paving with brick and curbing with granite about 17,000 sq. yds. and 6,000 lin. ft. respectively. N. J. Rouse, Mayor.

**Middletown, O.*—N. G. Oglesby, City Aud., writes that the contract for 23,554 sq. ft. walks, 5,497 lin. ft. curb, etc. (bids opened July 7) has been awarded to F. M. Kemp & Sons, of Middletown, for $4,293. He further states that bids will shortly be asked for work on sundry other streets.

Cincinnati, O.—See "Water."

Cincinnati, O.—City Engr. W. H. Sieverling is reported to have been selected to prepare estimates on the cost of paving with bitulithic macadam on Fountain Square.

Bids will be received until July 31 by the Bd. Pub. Service (Geo. F. Holmes, Clk.) for furnishing material and improving a portion of Hukill alley by paving with brick and constructing the necessary retaining walls, also until Aug. 14 for improving a portion of Warsaw Ave. by grading, setting curb and paving with bitulithic.

**Chillicothe, O.*—The Bd. of Pub. Service is stated to have awarded the contracts for paving portions of Water and Main Sts. to Jardine, Brewer & Tomlinson for $16,207 and $17,246 respectively.

Findlay, O.—It is reported that bids will be received until July 31 by W. Demland, City Aud., for $8,000 W. Hardin St. paving bonds.

It is stated that bids will be received until July 26 by the Co. Comrs. for constructing 4 miles of stone pike in Orange Township.

**Ashland, O.*—F. L. Niederheiser, City Engr., writes that the following are the bids opened July 11 for paving Cleveland Ave. with brick 9,600 sq. yds.: Phillips & Arnold, Ashland, $13,235 (awarded contract); Couch & Kunkel, Dayton, $15,036; Ohio Eng. Co., Elyria, $14,286; Thos. M. Hill, Toledo, $14,895; T. H. Foster & Co., Attica, Ind., $18,024; Humphrey & Scott, Marion, $16,309; Marion Wells, Ashland, $14,441; Wm. E. McHugh, Springfield, $16,334, and Heffner & Fishbaugh, Salina, $13,675. Phillips & Arnold also secured the contract for paving Pleasant St., 4,520 sq. yds. brick (bids opened July 11) for a total of $6,502. They bid for paving both streets with brick, 74½ cts. per sq. yd.

**Dayton, O.*—M. O. Herron & Co. has secured the contract for repaving 5th St. from River Bridge to Bway. (bids opened July 12). He bid for 11,200 sq. yds. brick paving 94 cts. per sq. yd. for Hocking Valley block; 97 cts. for Metropolitan block and 98 cts. for Logan block and $2.25 per sq. yd. for 120 sq. yds. concrete foundation.

Jersey Shore, Pa.—Bids will be received until July 29 by the Highway Com. for paving about 8,000 sq. yds. with brick on Allegheny St., as advertised in The Engineering Record.

Valley Forge, Pa.—Bids will be received until Aug. 1 by the Valley Forge Park Comn. of Pa. at the office of J. O. Clarke, Engr., 906 Crozer Bldg., 1420 Chestnut St., Philadelphia, Pa., for building stone roads in Valley Forge Park. Plans and specifications may be secured on a deposit of $5, which is to be refunded on return of same in good condition. A. H. Howren, Secy.

West Homestead, Pa.—Bids will be received until July 25 by the Boro. Council for grading, curbing and paving certain streets. Wm. Walton, Boro. Clk.

**Allentown, Pa.*—The Barber Asphalt Co. has secured the contract for paving Liberty, Jefferson and Madison Sts. with asphalt about 32,791 sq. yds. (bids opened July 18). This company bid for asphalt on 4-in. base, $1.89 per sq. yd.; replacing pavement, $2 per sq. yd.

Items marked thus give the names of parties awarded contracts.

setting new stone curb., 72 cts.; per lin. ft. cement, 50 cts.; relay stone gutters, 6 cts. and cement gutters, 14 cts.

Philadelphia, Pa.—Mayor Weaver is stated to have decided to annul the Torresdale Boule. contract.

Altoona, Pa.—It is stated that no bids were received on July 11 by the Bd. Pub. Wks. for repaving portion of 6th Ave. New bids will be received according to reports.

Bellevue, Pa.—The City Council is stated to have decided to pave Orchard, Vine, Howard Sts., Hawley Ave. and Hallett Pl.

*The contract for grading and paving Bryant Ave. is stated to have been awarded to Samuel Baumgardner, for $4,006.

**Providence, R. I.*—Peter J. Lannon, Clk. State Bd. Pub. Roads, writes that contracts for improving State highways (bids opened July 12) have been awarded as follows: To Lewis J. Pierec Bldg. Co., Providence, for the Bristol, Conventry and Glocester Roads, 18,425 ft. for $13,650; to Alton Head, of Jamestown, for Jamestonwn Road, 2,640 ft., $2,498; to John Walsh, of Johnstown, for the Johnstown Road, 10,560 ft., $5,582; to Herbert A. Cushing, of Sekonk, Mass., for Little Compton Road, 2,640 ft., $2,012, and to John Bristow, of Narragansett Pier, for Westerly Road, 5,280 ft., $4,786.

Knoxville, Tenn.—It is stated that bids are being received for the paving of Asylum Ave. and Walnut St. City Engr. Moreland estimates the cost at $23,291.

**Ogden, Utah.*—P. J. Moran, of Salt Lake City, has secured the contract for paving on 24th St., for $8,067.

**Seattle, Wash.*—Bids were opened July 8 for paving 2d Ave. and other streets with asphalt. The following are the totals and unit prices on some of the principal items: (*a*) Independent Asphalt Paving Co., $75,060 (awarded contract), (*b*) Barber Asphalt Paving Co., $79,028:

	**a*	*b*
12,000 cu. yds. sub-grading	$0.25	$0.40
1,215 lin. ft. 12-in. pipe sewer	1.30	1.35
5 manholes	50.00	50.00
11 catch basin	55.00	50.00
9,600 lin. ft. granite curb (straight)	1.30	1.35
560 lin. ft. granite curb (curved)	1.50	1.55
10,600 lin. ft. sub-drains	.12	.15
22,350 sq. yd. asphalt pavt	1.87	1.90
24,700 sq. yd. gravel foundation	.13½	.15
2,050 sq. yd. brick gutters and alley cross.	2.40	2.39
280 lin. ft. 8-in. C. I. pipe	1.00	1.25

Seattle, Wash.—G. W. Evans, of the County Engrs.' office, is stated to have prepared plans for a 2-mile speedway to be constructed from Rainier Boule. to Meadows's Drive. The road to be 70 ft. wide and cost about $10,000.

Bids will be received until July 29th, by C. B. Bagley, Secy. Bd. Pub. Wks., for regrading 3d Ave. and other streets, at an estimated cost of $54,000.

*The following are the bids opened on July 15 for brick paving, etc., on Connecticut and other streets (bidders all of Seattle): Sparger Concrete Co., $17,602; Bell & Price, Marion Blk., $17,034 (awarded contract); J. Markey, $17,738; Stirrat & Goetz, $18,187; T. Ryan, $17,205. The successful bidders, Bell & Price, bid for 8,500 cu. yds. earthwork, 25 cts.; 456 lin. ft. 5½ ft. brick sewer, $10; 206 lin. ft. 18x30-in. wood box sewer, $1.50. 672 lin. ft. granite curb. (straight) $1.25; 2,730 sq. yds. brick pavt., $2.30, and 420 lin. ft. 12-in. c. i. pipe, $2.30.

Tacoma, Wash.—The City Council is stated to have passed ordinances providing for the improvement of portions of the following streets: N. Lawrence, S. Hosmer, S. 8th and S. Chandler Sts.

The contract for paving No. 2d and 3d Sts. (bids opened July 1) has been awarded to Barber Asphalt Co., of Tacoma, for $6,937.

*B. W. Dibler is stated to have received the contract for laying cement sidewalks in Local Improv. Dist. No. 277, including S. Tacoma Ave., Yakima and several other streets, for $24,510.

**Chehalis, Wash.*—The Lewis County Comrs. are stated to have awarded the contract for building the grade for the new public highway between Chehalis and Centralia to J. Alred and S. James for about $3,000.

Green Bay, Wis.—It is stated that bids will be received until Aug. 7 by the Com. on Streets and Bridges for grading, macadamizing and laying combined cement curb and gutter on Webster Ave. and Porlier St. Approximate quantities: 14,800 lin. ft. combined cement curb and gutter, 27,378 sq. yds. macadam pavement and 15,366 cu. yds. excavating and grading.

**Calgary, Alta. Can.*—F. W. Thorold, City Engr., writes that Marshall Batchelor & Sharin have secured the contract for 109,000 sq. ft. concrete walk (bids opened June 7) at 9.5 cts. per sq. ft.

POWER PLANTS. GAS AND ELECTRICITY.

Notes Arranged Alphabetically by States.

Elba, Ala.—The Pea River Power Co. is reported incorporated with a capital of $100,000 by Chas. Henderson, H. D. Boyd, J. M. Garrett and others, to supply Elba with electricity for lighting, heating and power purposes.

Dothan, Ala.—It is reported that it is proposed to improve the water works and electric light plant, at a cost of $20,000.

Fairbank, Alaska.—The Tanana Electric Co. is reported to have been incorporated at Olympia, Wash., on July 8 by Abe Spring, of Fairbank, and J. A. Haney, of Seattle, Wash., with a capital of $250,000, to establish a lighting and steam plant at Cleary City, Alaska, which is about 25 miles from Fairbank.

Argenta (P. O., Little Rock), Ark.—A. B. Gerlach, City Clk., writes in regard to the construction of water works and an electric light plant, that the cost of the work has not yet been determined, and city is not yet ready for bids.

Washington, D. C.—Bids will be received until Aug. 10 by the Treas. Dept. (J. B. Reyonlds, Asst. Secy.) at Washingtou, D. C., for furnishing and installing certain combination gas and electric light fixtures in the U. S. Post-Office at Elkhart, Ind., and Baraboo, Wis.

Wm. Bayley Upton, of Washington, is stated to have secured the contract for installing the heating, lighting and power plant and the water supply for the new Industrial Home School at Blue Plains, D. C., for $34,367.

Jacksonville, Fla.—Bids will be received until Aug. 4 by the Bd. of Trus. of the Water Wks. and Improvement Bonds, for furnishing f. o. b. cars Jacksonville, a motor generator set of about 300-kw. capacity, the generator to be a 550-volt, direct-current, compound-wound machine, driven by a direct-connected, 3-phase, 60-cycle 2,300-volt synchronous motor, large enough to drive the direct-current generator to its rated capacity. machine to be arranged so as to be reversed, and an alternate bid for the same generator driven by a 3-phase, 60-cycle, 2,300-volt induction motor, direct connected, of sufficient size to drive the generator to its rated capacity, the speed of the machine not to exceed 750 revolutions per minute, the machine to be mounted on a substantial c. i. base and to have large self-oiling bearings. Field rheostat for the D. C. machine and starting device for the A. C. machine to be furnished, a full specification, giving dimensions, together with blue print or photograph to accompany the bid, and state time in which delivery can be made. R. N. Ellis, Supt.

Pensacola, Fla.—The following are the bids opened on July 15 by the Bureau of Yards and Docks, Navy Dept., Washington, D. C., for constructing a central power house, Bldg. No. 47, Navy Yard, Pensacola. (Each bid contains deductions and modifications): Grant Wilkins, Atlanta, Ga., $72,400; Penn Bridge Co., Beaver Falls, Pa., $74,949; Henry & John Monk, Pensacola, $87,750; Morse De Leon, English-American Bldg., Atlanta, Ga., $68,169; and C. H. Pittman, Atlanta, Ga., $86,233.

Ft. Gaines, Ga.—The City Council is reported to have granted the Interstate Water Works & Constr. Co., of Washington, D. C., a 50-year franchise for the construction of water works and an electric light plant.

Cartersville, Ga.—W. A. Carlisle, of Gainesville, Ch. Engr. Etowah Power Co., writes that surveys are now being made for the proposed plant, but estimates have not yet been prepared.

Valdosta, Ga.—The City Council is reported to have granted W. C. Lewis and F. W. Armstrong, of Tallahassee, Fla., a franchise for the construction of a gas plant.

Camilla, Ga.—An election will soon be held to vote on issuing $6,000 bonds for improving the electric light plant.

Mountain Home, Idaho.—Seymour H. Bell and Chas. H. Chance, of Sumpter, Ore., are stated to have secured a franchise for an electric light plant.

Belleville, Ill.—The Belleville Retail Merchants' Association is reported to be arranging to organize a company, to construct an electric light and gas plant.

Crawfordsville, Ind.—The Crawfordsville Water & Light Co. is stated to have secured a new franchise, and will at once make extensive improvements and purchase new machinery.

Wabash, Ind.—It is reported that Saml. Murdock and others will soon ask for bids for the construction of a generating and heating plant to supply Wabash, Peru and Logansport. The natural gas mains will be used to distribute the fuel gas.

Poseyville, Ind.—The Poseyville Electric Light & Water Co. is reported incorporated, with a capital of $10,000.

Peru, Ind.—Wm. O'Hara, City Clk., writes this city has in contemplation the reconstruction of its electric light plant, and would like to have some one complete the project, both financially and mechanically.

**Pittsburg, Kan.*—E. V. Lanyon, pres. Home Light, Heat & Power Co., writes that the contract for furnishing electric machinery and apparatus for the new light and power station (bids opened July 12) has been awarded to the Westinghouse Machine Co., of Pittsburg, Pa.

Russell, Ky.—E. E. Fullerton and H. Willis, of Greenup, are reported interested in the construction of an electric light plant in Russell.

Lake Providence, La.—See "Railroads."

Bangor, Me.—We are informed under date of July 14, that Wallace C. Johnson, of Niagara Falls, N. Y., is engineer for the proposed power plant of the Bodwell Water Power Co., and that no contracts have been awarded as yet.

Brunswick, Md.—G. R. Bready, of Harpers Ferry, W. Va., Gen. Mgr., Harpers Ferry Electric Light & Power Co., writes in regard to work contemplated at Brunswick that about $12,000 will be expended, but contracts have all been closed with the exception of a 95-kw alternator.

**Leominster, Mass.*—The Leominster Electric Light & Power Co. has secured the contract for lighting the city for the coming year at the following bids: 92 arc light at $72 per yr. ea. to burn until 1 A. M., 20 arc lights to burn all night at $110 per yr. and 72 incandescents at $10 ea.; total cost $9,976 per yr.

Austin, Minn.—It is reported that the Electric Light, Power and Water Comn. will expend about $20,000 for improvements at the electric light plant.

Farmington, Mo.—Bids will be received until July 31 by the Bd. of Mgrs. of State Hospital No. 4 at Farmington (W. W. Waters, Secy.), for constructing a sewage system; erecting additions to laundry, power house and dining-room buildings; additional equipment in power house, consisting of boiler, engine, generator and purifying water system.

Lincoln, Neb.—The following are the bids opened July 11 by the Superv. Archt., Treas. Dept., Washington, D. C., for the installation of a conduit and electric wiring system for U. S. Post-Office at Lincoln: McMaster & Fletcher, Columbus, O., $4,300; National Electric Co., Omaha, Neb., $4,315 and Western Electric Co. Omaha, $4,584.

New York, N. Y.—The Bd. of Estimate on July 14 approved the report of Nelson P. Lewis, Ch. Engr. Bd. of Estimate, on the proposed municipal electric light plant, and authorized him to prepare specifications for a contract for submission to the Corporation Counsel; probable cost of plant, $7,500,000. Contract for construction will probably be let in the fall.

Little Falls, N. Y.—Jas. G. Hazlett, City Clk., writes that the Hudson River Power Co. has petitioned for a franchise for lighting and power purposes.

Spring Valley, N. Y.—The question of constructing an electric light plant at a cost of $25,000 is reported under consideration.

Albion, N. Y.—Alice E. Curtin, Supt. Western House of Refuge for Women, writes that all bids opened July 13 for the electric wiring exceeded the appropriation.

Parish, N. Y.—The Parish Lighting Co. is reported incorporated, with a capital of $2,000 to manufacture gas for lighting. Incorporators: R. C. Robertson and Geo. Weaver, of Parish.

Ogdensburg, N. Y.—It is reported that electric power, generated at Hannawa Falls, 30 miles from Ogdensburg by the Hannawa Falls Water Power Co. is to be transmitted to this city for use of the Ogdensburg Power & Light Co.

Plymouth, O.—Bids will be received until July 25 by W. A. Jeffrey, Village Clk., for $6,000 bonds, issued for the purpose of equipping and furnishing a combined water works and electric light plant.

Ashland, Ore.—Milton Berry, City Recorder, writes that the citizens voted July 11 to issue $50,000 bonds for constructing a municipal electric light plant.

Girardville, Pa.—Bids will be received until Aug. 7 by M. J. Walsh, Chmn. Light Com., for lighting the streets with about 25 lights of the highest power for a period of 5 or 10 years, commencing Jan. 1, 1906, the annual cost not to exceed $1,500. Robt. Pryce, Clk. Town Council.

Spartanburg, S. C.—Engineers Ladshaw & Ladshaw, of Spartanburg, write that the Electric Mfg. Co. proposes developing water power at Nesbitt Shoals, at a cost of about $250,000, but nothing definite has yet been done.

Clarksville, Tenn.—The Consumers Electric Light, Htg. & Power Co. is stated to have petitioned for a franchise.

Chattanooga, Tenn.—W. B. Spencer, 16 Exchange Pl., New York, N. Y., Asst. Engr. of the Chattanooga Tennessee Power Co., of which J. C. Guild and C. E. James are the promoters, writes that bids for construction of the plant which will cost about $1,500,000 will be received in about 4 weeks. This water power electric plant, which will be constructed on Tennessee River about 12 miles from Chattanooga, will develop about 50,000 hp. The lock will be about 60 ft. wide, dam 40 ft. high and 1,200 ft. long; power house to be adequate for 14 units of 3,000 kw. ea. Transformer house and other buildings will be erected. John Bogart, Consulting Engr., 16 Exchange Pl., New York, N. Y.

Jefferson, Tex.—The Jefferson City Light & Power plant, including ice plant, is reported to have been destroyed by fire July 5.

Ephraim, Utah.—Bonds to the amount of $15,000 are reported sold, to be used for the construction of an electric light plant.

Tacoma, Wash.—The City Council on July 12 adopted the resolution authorizing the City Clk. to procure bids for the construction of a steam power electric generating plant, to be established if possible within the city limits. All bids to be submitted for a generating plant of at least 5,000-hp. and not more than 10,000 hp. A resolution was previously adopted for a water power generating plant. The idea is to secure bids on all kinds of plants for generating electric current.

Walla Walla, Wash.—An ordinance has been introduced in Council granting C. M. Maxwell and H. Day Hanford, of Seattle, a franchise to construct and maintain an electric light and gas plant in Walla Walla. It is proposed to organize a company to be known as the Walla Walla Gas & Electric Co.

Laramie, Wyo.—The City Council is reported to have granted Alfred E. Kalter, of Indianapolis, a franchise for an electric light plant.

Toronto, Ont.—The Hydro-Electric Power Comn. has been appointed by the Ontario Government to inquire into the whole question of electrical production and development in the Province of Ontario. Adam Beck, of London, is chmn., and Cecil B. Smith, Ch. Engr.

R. A. Ross, of Montreal, Que., and his staff of engineers on the Municipal Power Comn. are reported to be completing the field work in connection with the development of Niagara power, and the cost of transmitting it to Guelph, Hamilton, St. Catherines, Galt, Brantford, London and other western Ontario towns and cities.

Napanee, Ont.—W. A. Grange, Town Clk., writes that the proposed electric light plant will cost about $35,000. No engineer selected as yet.

ELECTRIC RAILWAYS.

Notes Arranged Alphabetically by States.

Washington, D. C.—Plans are on foot, its is stated, for the building of an electric railway that will connect points in Fauquier, Loudoun, Fairfax and Alexandria Counties, in Virginia, with Washington. The charter was recently granted by the Virginia Corporation Commission to the new company, and under its terms the line is to be built from Upperville, Fauquier County, through Aldie and Middleburg, in Loudoun County, to the new highway bridge. It is stated that M. E. Church, of Falls Church, is the president of the proposed road, and among thoses interested is ex-Senator John B. Henderson.

South Bend, Ind.—The South Bend Western R. R. Co. is stated to have closed a contract with George Townsend, of Indianapolis, for the construction of an electric line from South Bend to LaPorte, 30 miles west. The completion of this line will give South Bend electric railway connection east, west and north.

Council Bluffs, Ia.—The promoters of the proposed electric line from Council Bluffs to Griswold are reported to have organized temporarily with H. H. Van Brunt as president. Those associated with him are Congressman Walter I. Smith, H. A. Quinn and others. The company will be reorganized and the capital stock fixed after the survey is completed.

Worcester, Mass.—It is stated that the Worcester & Northern St. Ry. Co. is shortly to award the contract for the construction of 14 miles of track from Princeton to Jefferson, this being a continuation of its present line.

Sault Ste. Marie, Mich.—Sheridan F. Masters is reported to be promoting a project for building an electric railway between the Soo and Bay City. The right of way for the line is secured south of Cedarville, giving an air line to Lake Huron opposite the Les Cheneaux Islands. The road will cost $350,000.

Items marked thus give the names of parties awarded contracts.

Bay City, Mich.—The Bay City & Caro Ry. Co. is stated to have secured a franchise to construct an electric railway. It is the intention of the company to build straight to Saginaw and thence to Chesaning and St. Johns.

Benzonia, Mich.—The Business Men's Assoc. is reported interested in a project for the building of a 20-mile electric line. The proposed route is along the shores of Crystal Lake, connecting the resorts, through Benzonia to Beulah and Honor.

New York, N. Y.—The Bd. of Estimate on July 14 approved of a spur in the subway system from Manhattan St. to Ft. Lee Ferry and also the extension from 230th St. to Van Cortland Park, these to be built at once under the original contract with the Belmont syndicate. Other routes for Manhattan Boro. approved were Lexington, 3rd, 7th and 8th Aves. The Brooklyn routes approved were 4th Ave. over Manhattan Bridge to Eastern Parkway and from 14th St. to University Pl. and through Brooklyn to Jamaica. Contracts, it is said, cannot be signed for these routes until certain litigation is settled.

Ticonderoga, N. Y.—The Ticonderoga Union Terminal R. R. Co. is reported incorporated to operate an electric line from the bridge of the Rutland Railway at Addison Junction to Ticonderoga. The distance is 5 miles. Capital, $50,000. Directors: Isador Rothchilds, Ancus B. Atkins, of Ticonderoga, and Frank B. Girdley and Northup R. Holmes, of Troy.

Trenton, N. J.—It is stated that the Trenton St. Ry. Co. has had engineers at work recently surveying extensions from the Interstate Fair Grounds to Mercerville and Hamilton Sq., also from a point west of the upper entrance of Cadwallader Park to Trenton Junction. Each of these extensions will be about 3 miles in length.

Cleveland, O.—C. H. Hubbell and others are reported to have formed the Cuyahoga Traction Co., and propose to build a suburban line from South Brooklyn, through Parma and Middleburg, to Berea.

**Lima, O.*—Cliff Wise, of Lima, is stated to have closed a contract for the construction of 36 miles of road between Muncie and Portland, Ind. The work is for the McCullough interests.

Lorain, O.—The Oberlin & Lorain Railway Co. recently formed, is stated to have commenced surveys and is securing right of way. The line will enter South Lorain.

Toledo, O.—The Detroit, Monroe & Toledo Short Line Ry. Co. is reported to have announced that a line will be built from Monroe to Dundee, and that ultimately the line will be extended to Tecumseh and Adrian. Matthew Slush, Pres.

Dayton, O.—The Dayton & Xenia Traction Co. is stated to have in contemplation the construction of a line to connect with the Rapid Transit line owned by the same company.

East Liverpool, O.—It is reported that the United Power Co. contemplates construction of an extension of its line through Smith's Ferry to Industry, Pa.

Columbus, O.—The Central Market St. Ry. Co. is stated to have under consideration the construction of a short extension on its North Side line to enable it to reach Indianola Park.

Youngstown, O.—Horace T. Smith, of Youngstown, and Robert L. Walker, of Poland, are reported to be forming a company, and have secured a right of way for the purpose of building an electric railway from Youngstown to Poland, a distance of about 8 miles. It is proposed to connect with the lines of the Pennsylvania & Mahoning Valley Railway on the outskirts of Youngstown.

It is stated that the Youngstown & Southern Ry. Co. has abandoned the plan of making this a third-rail system and will equip it with overhead trolley instead. Work is to start immediately on the extension of the line from its present terminus at Columbiana to Leetonia, Lisbon and East Liverpool, and there will be a spur line from Leetonia to Salem.

Sheffield, Pa.—It is reported that grading for an extension of the Youngsville & Sugar Grove Electric Ry. from Sugar Grove to Panama via Lakewood will shortly be commenced. It is the purpose of the company to ultimately extend the line from Panama to North East via Findlay Lake.

Washington, Pa.—It is stated that the Wheeling & Elm Grove Ry. is to be extended from West Alexander to Washington. Henry Smulbach, Pres.

**Johnstown, Pa.*—The Tennis Bros. Co., of Pittsburg, is stated to have secured the contract to build the new electric line connecting Patton, Carrolltown, St. Benedict, Spangler and Barnesboro, and several miles of line have been graded.

Chambersburg, Pa.—It is stated that the Chambersburg, Greencastle & Waynesboro and the Chambersburg & Gettysburg Electric Railway Cos. are securing rights of way for proposed extensions between Chambersburg and Greencastle.

Dallas, Tex.—The Texas Traction Co. is reported organized with J. F. Strickland, Pres.; W. R. Brents, of Sherman, Treas. The company contemplates building one line to Sherman; another to Terrell, and a third to Waxahachie.

Ft. Worth, Tex.—Major J. D. Beardsley, of Gibsland, La., is reported interested in the construction of an interurban electric railway between Ft. Worth and Mineral Wells.

Sherman, Tex.—The Gainesville, Whitesboro & Sherman Ry. Co. is stated to have received a franchise to construct a railway in Sherman.

RAILROADS.

Notes Arranged Alphabetically by States.

Bloomington, Ill.—It is reported that plans are being prepared by the Chicago & Alton R. R. Co. (G. H. Kimball, Ch. Engr., Chicago), and Illinois Central R. R. Co. (A. S. Baldwin, Ch. Engr., Chicago) for track elevation through Bloomington and Normal.

Evanston, Ill.—The City Council on July 11 passed an ordinance requiring the Chicago & Northwestern R. R. Co. (E. C. Carter, Ch. Engr., Chicago) to elevate its tracks within the city limits, a distance of 2 miles at an estimated cost of $4,000,000, the work to be completed before Jan. 1, 1910.

Great Bend, Kan.—The Great Bend & Gulf R. R. Co. is reported formed with a capital of $1,500,000 to construct a railroad from Great Bend to the Southern boundary line of the State.

Lake Providence, La.—The Lake Providence & Gouldsboro Ry. & Power Co. is reported organized, with a capital of $100,000 to build a railroad, electric light and power lines, telegraph and telephone lines and depots from Lake Providence to Gouldsboro.

Rochelle, La.—The Rochelle & Western Ry. is reported organized with a capital of $1,000,000 to build a railroad from Rochelle through portions of Grant and Winn parishes, to or near Winnfield, and easterly through portions of the parishes of Grant and Catahoula to Harrisonburg. F. C. Denkmann, Pres.; N. S. Cutright, Secy.

Dedham, Mass.—The New England R. R. Co. (the New York, New Haven & Hartford R. R. Co., lessee; Colin M. Ingersoll, Ch. Engr., New Haven, Conn.) is reported to have filed with the Norfolk County Comrs., at Dedham, the proposed location of a branch or extension between West Roxbury and Needham, through a portion of Dedham, connecting the West Roxbury branch of the Boston & Providence division with the Woonsocket division of the New England road.

Raton, N. M.—The St. Louis, Rocky Mountain & Pacific R. R. Co. is reported to have decided to build a line from Des Moines, N. M., a point on the Colorado Southern, westward to Raton and thence southwest, crossing the Dawson R. R. at Koehler, thence to Cimarron and through the Cimarron Canyon to the Elizabethtown mining district, a distance of about 120 miles.

Bristol, Tenn.—A survey is reported to have been completed for the proposed Cairo & Tennessee River R. R. The road will have its terminus at Bristol, Tenn., and will run through the following Kentucky Counties: Whitley, Wayne, Clinton, Cumberland, Monroe, Allen, Simpson, Logan, Todd, Christian, Trigg, Calloway, Marshall, Graves, Carlisle and Ballard. Also through Hawkins, Hancock, Claiborne and Campbell Counties in Tennessee.

Brownsville, Tex.—Geo. L. Edwards, Edw. C. Elliot, and Thos. W. Carter, of St. Louis, Mo., and Duval West of San Antonio, Tex., representatives of the Yoakum interests, are reported to have been elected to the Board of Directors of the Rio Grande R. R. at the stockholders' meeting July 14. The sale of the road to B. F. Yoakum and his associates was confirmed at the meeting. It is reported that Mr. Yoakum will establish extensive terminal facilities at the port of Point Isabel on the Gulf Coast near Brownsville, which is the eastern terminus of the road.

Norfolk, Va.—The Carolina Coast R. R. Co. is reported organized at Elizabeth City, N. C., to build a railroad from Norfolk to Beaufort. W. B. Roper, of Norfolk, Va., Pres., and W. T. Harris, of Norfolk, Va., Secy.

Venezuela.—The National Government has decided to construct a railroad from Coro to El Isiro, to facilitate the transportation of coal extracted from the mines of State of Falcon. Jerome B. Peterson, Consul, Puerto Cabello, Venezuela.

PUBLIC BUILDINGS.

Notes Arranged Alphabetically by States.

Fresno, Cal.—W. H. Ryan, City Clk., writes that Eugene Mathewson is the architect for the proposed new city hall, to cost about $75,000. Date of election to vote on issuing bonds for same is not yet set.

Washington, D. C.—It is stated that as soon as plans are prepared bids will be asked by the Comrs. D. C. for erecting 2 comfort stations, 1 at 7th St. N. W. and Pennsylvania Ave. and the other at 13th St. and Pennsylvania Ave. The amount available for the 2 structures is $50,000.

W. E. Mooney, it is stated, submitted the lowest bid for erecting the boat house for the Firefighter at water front, between M and N Sts., at $10,388.

Chicago, Ill.—Patton & Miller, 140 Dearborn St., it is stated, have prepared plans for a hospital which is to be erected at 1639 Wabash Ave. by Dr. M. H. McKillop, to be 2 stories high, 35x160 ft. and to cost $25,000.

**Troy, Kan.*—Henry Wagenkneckt, of Wathena, it is reported has secured the contract to erect the court house, at $39,950. Contracts for heating, lighting and plumbing are to be let separately.

Louisville, Ky.—Bids will be received until Aug. 9 by the Louisville Free Pub. Library Bd. (Robt. W. Brown, Secy.) for erecting a public library. Pilcher & Tachau, Archts., 32 E. 28th St., N. Y. City.

Franklinton, La.—The plans of Andrew J. Brown, of New Orleans, for the new courthouse for Washington Parish have been accepted by the Police Jury. The building will be a fireproof structure, 76x180, and will cost about $22,000.

New Orleans, La.—Local press reports state that the Bd. Directors of the New Orleans Pub. Library will soon receive competitive plans for the new Carnegie Central Library, which is to be erected at Lee Circle and St. Charles Ave.

Worcester, Mass.—John P. Kingston, 518 Main St., has prepared plans for a fire department building, to cost about $26,000.

Holyoke, Mass.—It is reported that the Bd. of Aldermen has appropriated $60,000 for the erection of an armory.

St. Paul, Minn.—It is stated that it is proposed to erect an auditorium here at a cost of about $300,000, $200,000 being available at the present time.

Cambridge, Minn.—T. C. Blomgren, Co. Aud., writes that all bids opened on July 12 for installing steam heating apparatus in the court house, have been rejected. New bids will probably not be asked for again before next Spring.

Aberdeen, Miss.—Bids will be received until Aug. 8 by the Bd. Superv. (C. B. Smith, Clk.) for installing a steam heating system in the county jail.

St. Louis, Mo.—Bids will be receiver until July 28 by Chas. F. Gallenkamp, Custodian, U. S. Custom House, St. Louis, for repairs to the heating and hoisting systems in the U. S. Custom House, St. Louis.

Farmington, Mo.—See "Power Plants, Gas and Electricity."

Ft. Mott, N. J.—Bids will be received on Aug. 16 by Capt. Louis F. Gerrard, Jr., Q. M., U. S. A., Delaware City, Del., for removing 11 frame buildings to site indicated and raising one building on present site at Ft. Mott, as advertised in The Engineering Record.

New York, N. Y.—The Bd. of Estimate has appropriated $250,000 for the purchase of a site at Mt. Hope, Orange County, for a tuberculosis sanatorium.

Bids will be received until July 28 by John F. Ahearn, Pres. Manhattan Boro. for constructing a brick duct and exhaust air outlet box in the City Hall in connection with the ventilating system.

Bids will be received until July 31 by the Armory Bd. (Geo. B. McClellan, Chmn.) for furnishing material and making repairs to the 7th Regiment Armory and repairs to the quarters of the first signal corps in the new 71st Regt. Armory, both in Manhattan Boro., also for making repairs to armory for Squadron C, Boro. Brooklyn.

John H. Barker, it is stated, submitted the lowest bid on July 12 for erecting pavilions A and B of the New ellevue Hospital at $559,875.

*John C. Robinson, 113 Adams St., Chicago, Ill., has secured the contract for the interior finish for the U. S. Custom House at New York, for $1,037,281.

Brooklyn, N. Y.—Bids will be received until Aug. 3 by the Comrs. of Parks (John J. Pallas, Pres.) for furnishing material and erecting the Parade Ground Bldg. on westerly end of Parade Ground, parallel with Coney Island Ave.

Ft. Wood, N. Y. H., N. Y.—Bids will be received by Capt. Traber Norman, Q. M., U. S. A., Governor's Island, N. Y., until Aug. 7 (readvertisement) for constructing a post hospital at Ft. Wood, as advertised in The Engineering Record.

Albion, N. Y.—Alice E. Curtin, Supt. Western House of Refuge for Women at Albion, writes that no contract was awarded on July 13, for erecting, etc., two cottages and assembly hall.

Ft. Michie, N. Y.—Bids will be received until July 26 by the Constructing Quartermaster at New London, Conn., for construction, plumbing, heating and electric wiring a hospital building at Ft. Michie.

Southport, N. C.—Bids will be received until Aug. 21 by Jas. Knox Taylor, Superv. Archt., Treas. Dept., Washington, D. C., for constructing an infection hospital at Cape Fear Quarantine Station, Southport.

Cincinnati, O.—Bids will be received until Aug. 11 by Bd. Trus. Pub. Library of the School Dist. for installing a low-pressure steam or hot water heating system in the East End Carnegie Branch Library at Eastern and Donham Aves. Address Drausin Wulsin, Chmn. Bldg. Com.

Bids will be received until Aug. 14 by the Bd Pub. Service (Geo. F. Holmes, Clk.) for alterations and additions to the House of Refuge, work to include masonry, brick, carpentry and iron work, plumbing, etc.

Akron, O.—It is reported that bids will be received about July 25 for erecting the court house. J. Milton Dyer, archt., Cleveland, O.

North Yakima, Wash.—The Co. Comrs. have accepted the plans of Newton C. Canutt for the court house and will soon ask bids for the erection of same. Probable cost, $75,000.

Seattle, Wash.—It is stated that only local architects are to be asked to submit plans for the new city jail and receiving hospital, which is to be erected here.

The erection of a new fire department building at 3d Ave. and Pine St., at a cost of about $60,000, is reported under consideration.

Port Townsend, Wash.—It is stated that A. K. Bentley, of Portland, Ore., submitted the lowest bid for erecting a light station at Mukilteo Point at $11,000.

BUSINESS BUILDINGS.

Notes Arranged Alphabetically by States.

Hot Springs, Ark.—Jacob Kempner, it is reported, contemplates erecting an office and flat building at a cost of $40,000.

Houseley Bros., it is stated, will erect a 3-story brick business building, 101x104 ft., at Ouachita and Hickory Sts., at a cost of $20,000.

Pine Bluff, Ark.—The City Council has accepted the plans submitted by W. T. Tyler, of Little Rock, Gen. Supt. of the Iron Mountain R. R., for the depot which is to be erected here.

Los Angeles, Cal.—Contracts are stated to have been awarded for the erection of a 3-story 164x115 ft. building, to be erected at 3d and Main St., at cost of about $150,000. A. M. Edelman, Arch., 233 S. Bway. A. Levy, Prop.

Live Oak, Fla.—It is stated that the Ethel Hotel will be enlarged, at probable cost of $30,000. C. H. Brown and J. B. Barton are reported interested.

**Taylorville, Ill.*—L. W. Wilson, of Chicago, Ill., it is stated, has secured the contract to erect the opera house at $28,000. It is to be of stone, 4 stories high, 55x52 ft.

**Peoria, Ill.*—The contract for erecting the warehouse of Schipper & Block is stated to have been awarded to Valentine Jobst & Sons. The structure to be 4-story brick building and cost $22,000.

Monmouth, Ill.—J. R. Hanna, Pres. Monmouth Hotel Co., writes that it is proposed to erect a hotel to cost about $50,000. Architect, H. E. Hewitt, of Peoria.

Denver, Colo.—It is reported that plans are being prepared for a 5-story fireproof office building which is to be erected for the Denver City Tramway Co. (Thos. Keely, Secy., Majestic Bldg.) at 15th and Arapahoe Sts., at a cost of about $250,000.

Items marked thus give the names of parties awarded contracts.

Springfield, Ill.—The Bd. of Dir. of the Sangamo Club are stated to have decided to erect a club house, at a cost of $20,000.

Chicago, Ill.—C. A. Eckstrom, 131 La Salle St., it is stated, is preparing plans for a 6-story warehouse which is to be erected for the Chicago Dock & Canal Co., on St. Clair St., at a cost of about $200,000.
The Richard Carle Amusement Co., it is stated, contemplates erecting a theatre on State St. Capital, $50,000.

Chickasha, Ind. Ter.—The Chicago, Rock Island & Pacific R. R. Co. (W. L. Darling, Ch. Engr., Chicago, Ill.) is stated to have in contemplation the erection of a depot and several improvements here, at a cost of $65,000.

**Sioux City, Ia.*—The contract for the rebuilding of the Martin Block, 614 4th St., recently destroyed by fire, is stated to have been awarded to J. O. Payne. The contract was given for only part of the work, but it is said the entire cost of construction of the new building will amount to $35,000. The structure will be 3 stories.

Des Moines, Ia.—It is stated that Fleming Bros. contemplate expending $30,000 on improving the Rothwell Block on Walnut St.

Louisville, Ky.—The officers of the Louisville Jockey Club (M. J. Winn, Secy.), it is stated, have decided to erect an amphitheater on the grounds of the club to cost at least $50,000.
It is reported that the Union Station, used by the Louisville & Nashville R. R. (W. H. Courtenay, Ch. Engr., Louisville) and other railroads has been destroyed by fire.
The Jefferson Realty Co., it is stated, has filed articles of incorporation with a capital stock of $275,000 and intends erecting an 8-story office building at 4th Ave. and Jefferson St., of steel, stone and pressed brick. F. M. Andrews, of Dayton, O., is the archt.; Laurence S. Jones is one of the incorporators.

New Orleans, La.—The Fairbanks Co. is stated to have decided to erect a 5-story brick building at St. Joseph and Camp Sts., at a probable cost of $100,000.

Shreveport, La.—It is reported that the Elks of Shreveport willl soon let the contract for erecting a building for the society, at a probable cost of $35,000.

**Baltimore, Md.*—A building permit has been granted to John Glenn, Jr., to erect a 3-story store and office building at St. Paul St. and Bank Lane, to cost $36,000. D. W. & G. J. Thomas, builders.
*The following are reported to be the bids received for erecting the Professional Bldg. at Charles and Little Pleasant Sts. (Baldwin & Pennington, Archts., 311 N. Charles St.): Geo. A. Fuller Co., N. Y. City, $125,000 (awarded contract); John Waters, $135,000; R. H. Ford & Co., $139,875; John Stack & Son, $155,000; Murphy Constr. Co. $137,779; D. W. Thomas, $130,300; H. Smith & Son, $133,715; J. J. Walsh, $135,386, Henry S. Ripple, **$130,942.**
*John Hiltz & Son, 3 Clay St., it is reported, have received the contract to erect a 2-story lunch room for Jas. Whitcomb at 118 E. Baltimore St., at a cost of about $75,000. Chas. E. Cassell & Son, 411 N. Charles St., are the architects.
*The contract to erect the 4-story building for the *Sun* at Baltimore and Charles Sts., it is stated, has been awarded to Edw. Brady & Son, 1109 Cathedral St., at $289,206.
It is stated that bids will be received until July 27 by Simonson & Pietsch, Archts., American Bldg., for erecting a store building at Baltimore and Hanover Sts. for Isaac Hamburger & Sons, to be of steel and concrete, 8 stories high, 67x148 ft.

Manistee, Mich.—E. Hill Turnock, 76 5th Ave., Chicago, Ill., is preparing plans for the construction of a number of buildings for a Chautauqua assembly, to be located at the Meadow Lake assembly grounds at Manistee. The principal building will be a 3-story hotel, 380 ft. front, with accommodations for 300 guests, besides which there will be a gymnasium, 100x30 ft.. a kindergarten and fifty detached cottages. The entire improvement will cost about $250,000.

**Detroit, Mich.*—The contract for erecting the main building for the Michigan Agricultural Society at the state fair grounds is reported to have been awarded to A. J. Smith & Son, of Port Huron, for about $50,000.

Duluth, Minn.—It is stated that a Y. M. C. A. building will be erected in the West End, at a probable cost of $50,000.

Glenwood, Minn.—It is reported that bids will be received until July 29 for erecting a 2-story store and opera house. J. H. McCauley, owner.

Kansas City, Mo.—Howe, Hoit & Cutler have prepared plans for an addition to the Savoy Hotel, at 9th and Central Sts., to cost $175,000. Owners, Arbuckle Bros.
A brick warehouse will be erected at 134-142 Main St. for C. A. Benton, to cost $30,000.
The Kaw Valley Land Co. will erect a brick store building at 1108-12 McGee St., to cost $15,000.

**St. Louis, Mo.*—W. M. Sutherland, Odd Fellows Bldg., is stated to have received the contract for erecting a 5-story, 80x95-ft., brick building for the Peter Haupmann estate at 3d and Vine Sts., for $57,000.
It is stated that a 14-story office building will be erected at Bway and Chestnut St., for the Blackstone Investment Co., at a cost of $300,000. Holbrook Blackwelder Co. representing the owners.
Theo. C. Linkk, Carleton Bldg., it is stated, is preparing plans for the Railroad Y. M. C. A. building, which is to be erected at Eugenia and Tom Sts., by Miss Helen Gould at a cost of about $100,000.

Omaha, Neb.—Fiske & Lawrie, Paxton Bldg., are preparing plans for a 6-story business building for J. R. Webster and J. A. Sunderland, to cost $250,000.

South Omaha, Neb.—The Nebraska Telephone Co. will build a branch exchange at South Omaha, to cost $100,000. T. R. Kimball, Archt., McCague Bldg., Omaha.

Rochester, N. Y.—The parish of St. Patrick Cathedral, it is stated, intends erecting a hall for parish meetings at Frank and Brown Sts., at a cost of about $30,000.

**Cleveland, O.*—The C. H. Fath & Son Constr. Co., Chamber of Commerce Bldg., it is stated, has received the contract to erect the 4-story brick building for Hunt & Dorman, at Bright & Fountain Sts., at a cost of about $15,000.

R. Crabb, of Bolton Ave., it is stated, has prepared plans for a storage warehouse, which is to be erected for the Thorman Investment Co., on Cross and Orange Sts., at an estimated cost of $50,000.

Toledo, O.—Bacon & Huber, The Spitzer, it is stated, have completed plans for a building for the Salvation Army, which is to cost about $50,000.

Springfield, O.—The Pennsylvania R. R. Co. (W. H. Brown, Ch. Engr., Philadelphia, Pa.) and the Cleveland, Cincinnati, Chicago & St. Louis R. R. (G. W. Kittredge, Ch. Engr., Cincinnati, O.), it is reported, intend erecting a union depot here.

Columbus, O.—It is reported that plans have been prepared by Richards, McCarthy & Bulford, Ruggery Bldg., for a 5-story fireproof retail store which is to be erected by David C. Meehan, at a cost of about $180,000. It is stated that the contract for the steel work has been awarded.

Canton, O.—Robt. Ostermeyer, Bank Bldg., has prepared plans for a 3-story hotel to be erected on N. Walnut St., for Louis J. Favret, to cost $15,000.

Cincinnati, O.—It is reported that bids will be received until July 26 by the Bldg. Com. of the Cincinnati Realty Co., for the mechanical plant which is to be installed in the Pike Hotel. Probable cost, $135,000.

Dayton, O.—It is stated that the National Cash Register Co. will erect a 130x220 ft. office building. Frank M. Andrews, Archt., Conover Bldg.

**Uhrichsville, O.*—P. A. Romig, of Uhrichsville, has secured the contract for erecting a brick building to be used for wholesale grocery, for $17,000.

Pittsburg, Pa.—The Pittsburg Grand Opera House Co. is reported to have selected McClure & Spahr, Keystone Bldg., to prepare plans for a 5-story steel and brick building, to be erected on 5th Ave., at a probable cost of $125,000.

**Philadelphia, Pa.*—Plans are stated to have been filed for the following buildings: a 2-story brick factory at Rockland and Stenton Aves., to cost $27,000, for Chas. Denny, Contr., 1330 Arch St.; a 2-story brick office building at Richmond and William Sts., to cost $25,000, Millard & McGraw, Contr., 1010 Arcade Bldg.; also a 6-story brick factory at Wallace and Broad Sts., to cost $80,000. Wm. Steele & Sons, Contrs., 1600 Arch St.

Wilkinsburg, Pa.—It is stated that the Wilkinsburg Bank officials have ordered plans prepared for a 5-story building to be erected at Ross Ave. and Wood St.

Nashville, Tenn.—It is reported that Norman Kirkman will erect a 4-story building to cost $70,000, replacing structure recently destroyed by fire.

Knoxville, Tenn.—Plans are reported to have been prepared for a 5-story steel building to be erected at Gay St. and Union Ave. for Miller Bros.

Dallas, Tex.—The erection of a Y. M. C. A. building, to cost $150,000, is reported under consideration.

**Leesburg, Va.*—The contract for the remodeling of the People's National Bank of Leesburg is stated to have been awarded to Norris Bros., of Leesburg, according to plans prepared by Mr. Paup J. Pelz, of Washington, D. C. The cost of the improvement will be about $25,000.

Tacoma, Wash.—It is stated that the Tacoma Hotel will be remodeled at a cost of $100,000.

Spokane, Wash.—Additions to the Northern Pacific (E. J. Pearson, Ch. Engr., St. Paul, Minn.) roundhouse, to cost approximately $45,000, are reported contemplated.
L. L. Rand, 516 Rookery Bldg., is preparing plans for a 3-story building for the Spokane Dry Goods Co., to cost $25,000.

Williamson, W. Va.—It is stated that the Norfolk & Western Ry. Co. (C. S. Churchill, Ch. Engr., Roanoke, Va.) will expend $65,000 on Y. M. C. A. buildings to be erected along the line at Williamson, W. Va.; Portsmouth, O.; Shenandoah, Va., and at Lambert's Point.

Racine, Wis.—The remodeling of the Y. M. C. A. building at a cost of $40,000 is reported under consideration.

Madison, Wis.—It is reported that the Chicago & Northwestern R. R. Co. (E. C. Carter, Ch. Engr., Chicago, Ill.) intends erecting a $50,000 passenger and freight depot here.

NEW YORK, N. Y.

Allen and Division Sts., 6-story br. and stone store and tenement; c, $45,000; o, Meyer Frank; a, Geo. F. Pelham.
225 Lewis St., 6-story br. and stone tenement and tsore; c, $20,000; o, Lewis Lewinthan; a, Horenburger & Straub.
18 E. 16th St., 7-story br. and stone loft building; c, $100,000; o, Union Realty Co.; a, B. W. Levitan.
348 E. 32d St., 3-story br. and stone milk laboratory; c, $30,000; o, Nathan Straus; a, John H. Duncan.
57th St. and 7th Ave., 12-story br. and stone hotel; c, $150,000; o and a, Alfredo S. G. Taylor.
84th St. and 1st Ave., 2 6-story br. and stone stores and tenements; total c, $77,000; o, Liebenthal Bros.; a, Geo. F. Pelham.
113th St. and 3d Ave., 2 6-story br. and stone stores and tenements; total c, $70,000; o, Passman & Seplow; a, Geo. F. Pelham.
Melrose Ave. and 157th St., 2 6-story br. stores and tenements; total c, $75,000; o, Huebner & Escher; a, Horenburger & Straub.
372 Pearl St., 5-story br. extension to 5-story br. and stone stores and loft bldg.; c, $22,000; o, E. Palmer; a, Ernest Greene.
304 E. 123d St., 6-story br. and stone store and tenement; c, $30,000; o, Wm. Soltz; a, Horenburger & Straub.
101st St. and Columbus Ave., 3 6-story br. and stone stores and tenements; c, $105,000; o, Navasky & Billowitz; a, Bernstein & Bernstein.
138th St. and Willis Ave., 2-story br. stores; c, $20,000; o, Thos. McNamara; a, Turner & Kilian.
177th St. and Cedar Ave., 1--story br. R. R. depot; c, $45,000. o, N. Y. C. & H. R. R. R. Co.; a Reed & Stern.
Arthur Ave. and 181st St., 2 5-story br. stores and tenements; total c, $60,000; o, Ernest Nammer & Son; a, Harry T. Howell.

CHURCHES AND DWELLINGS.

Notes Arranged Alphabetically by States.

Jacksonville, Fla.—It is stated that plans have been prepared for a new edifice to be erected at Ocean and Duval Sts. for the Church of the Immaculate Conception (Father Maher, pastor) at a cost of about $75,000.

Chicago, Ill.—Wilmore Alloway, Marquette Bldg., it is stated, has prepared plans for a 3-story apartment house, 48x68 ft., which is to be erected at S. 40th Ave. and Fillmore St., for A. Heinlein, at a cost of $43,000.
Wm. J. Brinkmann, 163 Randolph St., is preparing plans for a new church to be built at Sedgwick and Locust Sts. for the R. C. St. Dominick congregation. The building will be constructed of pressed brick and stone, and will cost about $50,000.
The Swedish Evangelical Mission Covenant, the Rev. Carl A. Bjork, president, has decided to build a charity home for the aged, and a building committee has been appointed to make the necessary arrangements. Edward structure, which is to cost about $40,000.
Benson, 1779 N. Clark St., will be the architect of the

**Des Moines, Ia.*—The contract for the masonry and carpentry work on the apartment house at 13th and Locust Sts., it is stated, has been awarded to W. T. Mitchell & Co., 116 8th St., at $30,000.

Louisville, Ky.—Walter S. Adams, it is stated, is interested in the erection of an apartment house at Walnut and 2d Sts., to cost about $200,000.

Cumberland, Md.—Wm. C. Dececmon, it is stated, has purchased a site on Washington St. and intends erecting a residence at a cost of $35,000.

St. Louis, Mo.—F. A. Banister, it is reported, has purchased a site at Taylor and McPherson Aves., and will erect a $100,000 apartment house.

Summit, N. J.—Wm. Allen Balch, 5 West 31st St., New York, N. Y., is preparing plans for a large residence to be erected at Summit.

Long Branch, N. J.—The members of St. James Church (Rev. Elliot White, Rector) it is stated, are contemplating the erection of a new edifice at a cost of about $25,000.

Cleveland, O.—Otto Leisy, it is stated, is having plans prepared by L. W. Thomas, 262 Prospect St., for a residence which he intends erecting at a cost of $50,000.
The congregation of the St. Lavislas R. C. Church, it is reported, has accepted plans prepared by E. M. Ulrich, Colonial Arcade, for a new edifice which is to cost about $50,000. Rev. John S. Dozil, Pastor.

Philadelphia, Pa.—Clarence M. Clark, it is reported, will erect a residence to cost $50,000. Horace Wells Seller, Stephen Girard Bldg., is the Archt.

Pittsburg, Pa.—J. T. Steen, Smith Blk., it is stated, has prepared plans for a 12-story apartment house which Edw. F. Jackman contemplates erecting at 5th Ave. and Bidwell St., at a cost of $350,000.

Sharpsburg, Pa.—It is reported that the members of the Presbyterian Church contemplate erecting an edifice at 13 and N. Canal Sts., at a cost of $50,000. Rev. Dr. T. M. Thompson, pastor.

Memphis, Tenn.—It is reported that W. S. King will erect a residence in Evergreen at a cost of $20,000.

Racine, Wis.—The members of the Welch Presbyterian Church, it is reported, are having plans prepared for a $25,000 edifice. Address pastor.

Milwaukee, Wis.—Two brick and stone apartments are to be erected at 13th and Wells Sts. by John Hunholz, at an aggregate cost of $70,000.
A building permit has been issued to Mrs. Caroline Wolf to erect an apartment house at Wells and 17th Sts., at an estimated cost of $20,000. Wolff & Ewens, 558 12th St., are the archts.

**Superior, Wis.*—Danl. Egan, it is stated, has secured the contract to erect the St. Francis Xavier R. C. Church in the East End, at $26,800. Other bids received were: Edw. Jackson, Duluth, $28,700; Joos & Osmundson, $39,600; Schmidt Bros., $28,687 and John Donlin, $32,685.

Beloit, Wis.—Koch & Sons, of Milwaukee, it is reported, have been directed to prepare plans for a $30,000 edifice for the members of the Presbyterian Church.

New York, N Y

St. Nicholas Pl. and 150th St., 5-story br. and stone tenements; c, $84,000; o, Murray & Hill; a, John C. Cocker.
146th St. and Convent Ave., 2 5-story br. and stone tenements; total c, $90,000; o, Jos. Neumark; a, John Hauser.
160th St. and Amsterdam Ave., 2 5-story br. and stone tenements; total c, $70,000; o, Roosevelt Realty & Constr. Co.; a, Saml. Sass.
170 St. and Audubon Ave., 2 5-story br. and stone tenements; total c, $130,000; o, Geo. Vogt; a, Lorenz F. J. Weiher.
7th Ave. and 136th St., 6-story br. and stone tenement; c, $50,000. o, P. & I. Simon; a, E. A. Meyers.
Fox and Home Sts., 2 5-story br. tenements; total c, $60,000; o, Irving Realty Co.; a, Harry T. Howell.
Simpson and 167th Sts., 2 5-story br. tenements; total c, $48,000; o, Michael Mulsan & Co.; a, Robt. Glenn.
153d St. and Melrose Ave., 5-story br. tenement; c, $50,000; o, Morris & Sussman; a, Geo. F. Pelham.
175th St. and Marmion Ave., 3-story br. dwelling; c, $25,000; o, Jos. A. Bertin; a, B. Ebeling.
169 Mulberry St. 6-story br. and stone tenement; c, $22,000; o, D. Briganti; a, A. Cagliostro.
Ave. C and 3d St., 2 6-story br. and stone tenements; total c, $90,000; o, Mayer Frank; a, Saml Sass.
55 E. 64th St., 4-story br. and stone dwellingg; c, $58,000. o, Mrs. A. T. Nichols; a, C. P. H. Gilbert.
110th St. and Park Ave., 2 6-story br. and stone tenements; total c, $80,000; o, S. O. Davis; a, Bernstein & Bernstein.
111th St. and Park Ave., 2 6-story br. and stone tenements; total c, $84,000; o, I. Rothfield; a, E. A. Meyer.
113th St. and 2d Ave., 6-story br. and stone tenement; c, $50,000; o, Bigio Pernetti; a, L. F. J. Weiher.
415 E. 115th St., 2 6-story br. and stone tenement;

**Items marked thus give the names of parties awarded contracts.*

total c, $49,000; o, Vincenzo Buscemi, a, Eugene Ciccarelli.

122d St. and 2d Ave., 6-story br. and stone tenement; c, $30,000; o, Jos. Isaacs; a, Maximilian Zipkes.

109th St. and Manhattan Ave., 3 6-story br. and stone tenements; total c, $145,000; o, M. S. A. Wilson; a, Saml. Sass.

115th St. and 8th Ave., 6-story br. and stone tenement; c, $30,000; o, Isaac Potstein. a, Geo. F. Pelham.

Crimmins Ave. and 141st St., 5 5-story br. tenements; total c, $150,000; o, Moritz Klein; a, Horenburger & Straub.

Cauldwell Ave. and 156th St., 5 5-story br. tenements; total c, $200,000; o, Cauldwell Ave. Realty Co.; a, Moore & Landsiedel.

Davidson Ave. and Evelyn Pl., 5-story br. tenement; c, $30,000; o, H. N. Singhi; a, Henry Anderson.

SCHOOLS.

Notes Arranged Alphabetically by States.

San Francisco, Cal.—City Archt. Shea, it is stated, has been instructed to prepare plans for the Bay View, Monroe, Park Primary, Sunnyside and Bergerot Schools.

Golden, Colo.—The following are reported to be the bids received for erecting the Guggenheim Hall at Colorado School of Mines: Jas. H. Barry, Denver, $75,000; S. B. McClenken, Denver, $81,581; Edward Seerie, Jr., Denver, $70,425; Rundle, Mayer & Co., Denver, $66,020; W. E. Towers, Denver, $68,649; Peter Morrison, Denver, $73,963; Thomas H. O'Neil, Denver, $74,220; Morrison Constr. Co., $77,970; A. I. Gray, Denver, $76,000; Brown & Schrepferman, $79,649. Philip Funke, Denver, $70,790; Keystone Realty Co., $80,788.

The lowest bid received for the plumbing of same, it is stated, was submitted by J. H. Linder & Co., of Golden, at $1,017.

Watertown, Conn.—It is reported that the School Bd. will erect a $25,000 school in Bunker Hill School Dist.

Washington, D. C.—Bids will be received until July 29 by the Comrs. D. C. (Henry B. F. MacFarland, Chmn.) for constructing buildings for the Industrial Home School in the subdivisions of Bellevue and Blue Plains, D. C.

Decatur, Ill.—It is reported that the School Bd. will soon ask bids for erecting 2 schools to cost about $30,000 each.

**Layfayette, Ind.*—Archts. R. P. Daggett & Co., Marion Blk., Indianapolis, writes that the contract for erecting a stone building for Dept. Civil Engineering of Purdue Univ. (bids opened July 12) has been awarded to the Wm. P. Jungclaus Co., of Indianapolis, for $42,000.

Clinton, Ia.—It is reported that a $40,000 school is to be erected on the North Side.

**Haverhill, Mass.*—Kelly Bros., of Haverhill, have secured the contract for erecting a school in Ward 5, for $12,775.

Woburn, Mass.—The following are reported to be the bids opened by the Bd. Pub. Wks. on July 10 for erecting the superstructure of the high school: P. H. Jackson & Son, $81,405; Dillon Bros., $88,793; Driscoll & O'Brien, $88,873; Woodbury & Leighton, $88,974; J. J. Prindivelle, $89,744; J. E. Locabelle, $91,090; H. P. Cummings & Co., $92,587; Henry McGahey, $97,711; L. P. Soule & Son Co., $101,737; Wm. C. Edwards, $105,121.

**Worcester, Mass.*—The contract to erect a 4-room brick school on Wilson St., it is stated, has been awarded to Kelly Bros., at $12,775.

Detroit, Mich.—Bids will be received until July 25 by the Bd. of Educ. (Geo. Brown, Secy. & Bus. Mgr.) for furnishing material and erecting the Sill and Capron Schools. each to contain 15 rooms.

South St. Paul, Minn.—The citizens have voted in favor of issuing $50,000 bonds to erect a high school.

Newark, N. J.—Plans have been approved by the Dept. of Bldgs. for 2 schools to be erected in the 6th and 8th Wards, at a total estimated cost of $140,000.

New York, N. Y.—Plans have been filed for a 4-story brick school to be erected at 1st Ave. and 80th St. for the City of New York, at a cost of $25,000. C. B. J. Snyder, Archt., 500 Park Ave.

Bids will be received until July 31 by C. B. J. Snyder, Supt. School Bldgs., N. Y. City, for sanitary work and gas fitting and plumbing in Erasmus Hall high school, also installing, ventilating and heating apparatus in Erasmus Hall high school, Boro. Brooklyn; general construction, etc., of additions to school No. 25, additions to and alterations in ventilating and heating apparatus in school No. 52, installing, ventilating and heating apparatus in school No. 64, installing electric elevators in De Witt Clinton High School, all in Boro. of Manhattan; for the general construction of addition to school No. 29, additions to and alterations in ventilating and heating apparatus in school No. 29 and for alterations in ventilating and heating apparatus in school No. 30, all in Boro. of Queens.

*The following are the bids opened July 17 by C. B. J. Snyder, Supt. School Bldgs., for general construction, etc., of addition to and alterations in School 52, Manhattan Boro.: Tolmie & Kerr, $24,657; Alfred Nugent's Sons, $25,790; Thos. McKeown, 267 W. 30th St., $20,489 (awarded contract); Wm. Werner, $25,635; Jas. Buckley, $20,500; J. & L. Moreland Co., $22,650.

*Bids were opened same time and place for sanitary work and gas fitting of school 40, Boro. of Bronx: Rossman & Bracken Co., $14,547. Jas. Fay's Son, 205 E. 51st St., $13,482 (awarded contract); Frank J. Fee, $15,781, and Jere. J. Deady, $14,200.

Syracuse, N. Y.—Prof. Fredk. W. Revels and Earl Hallenbeck of the Archt. Dept. of Syracuse Univ., it is stated, have completed plans for the Carnegie Library to be erected on the campus.

**Albany, N. Y.*—The M. L. Ryder Bldg. Co., 217 Lark St., it is stated, has received the contract to erect school No. 16 at $29,833.

Durham, N. C.—The plans prepared by Wheeler, Runge & Dickey, of Charlotte, it is stated, have been accepted by the School Com. for the High School. Cost $37,000. It is stated that bids for the erection are soon to be asked.

Minot, N. D.—It is reported that bids will be received until Aug. 8 by the Bd. Educ. (D. Cameron, Secy.) for erecting a school.

Marion, O.—Chas. V. Berry, of Mansfield, it is reported, submitted the lowest bid for erecting the $35,000 school.

Oberlin, O.—C. P. Doolittle, Supt. Bldgs. & Grounds of Oberlin College, writes that bids will be received at once by Cass Gilbert, 79 Wall St., New York, N. Y., for a chapel for Oberlin College, to cost about $100,000.

Girard, O.—Bids will be received until Aug. 4 by the Bd. Educ. (L. R. Mateer, Clk.) for erecting an 8-room school on North Ave. and Prospect St.

Marietta, O.—It is stated that $80,000 is available with which it is proposed erecting a library and dormitory at the Marietta College.

Rocky River, O.—Bids will be received until Aug. 12 by C. H. Dean, Clk. Bd. Educ., for furnishing material and erecting a 4-room addition to the Beach School. Work to include masonry, carpentry, concrete, brick and cut-stone work, ventilating, heating, etc.

Cleveland, O.—Bids will be received until Aug. 14 by the Bd. Educ. (Chas. Orr, Dir. of Schools) for erecting an annex to the Marion School, work to include mason-cut stone, carpentry, sheet metal work, iron and steel, ventilating and heating, plumbing, sewers and gas fitting, fireproofing, electric wiring, etc. Bids on material and labor to be submitted separately.

Allegheny, Pa.—It is reported that plans have been prepared for the $100,000 Manual Training School to be erected in the 2d Ward.

It is reported that the members of the Church of the Most Holy Name, Troy Hill, will erect a $45,000 convent and school. Address Pastor.

**Sharpsburg, Pa.*—The contract to erect a 16-room school on N. Canal St., it is stated, has been awarded to Golden & Crick, of Pittsburg, at $68,000.

Sharpsburg, Pa.—Bids will be received until July 25 by Hall & Stevens, archts., House Bldg., Pittsburg, for the plumbing and gas fitting, etc., of the Sharpsburg school.

Paris, Tenn.—A Com. has been appointed to select a site on which it is proposed erecting the Grove High School, for which there is $90,000 available.

Chattanooga, Tenn.—School bonds amounting to $75,000 have been issued.

Harrogate, Tenn.—It is stated that Andrew Carnegie has given $20,000 to the Lincoln Memorial Univ., with which to erect a library.

Dallas, Tex.—It is reported that the Trus. of the Texas Baptist Univ., have directed H. A. Overbeck, Slaughter Bldg., to prepare plans for the Univ. bldgs.

McKinney, Tex.—The Bd. Trus. of the Baptist College, it is stated, has selected a site in W. McKinney and will erect buildings at a cost of about $50,000.

Salt Lake City, Utah.—The Trus. of the Later-Day Saints Univ., it is stated, are contemplating the erection of a gymnasium to be 3 stories high, of brick and stone, and cost about $100,000.

**Bellingham, Wash.*—The School Bd., it is reported, has awarded the contract to remodel a school to Booker & Campbell, at a cost of about $12,950.

Stoughton, Wis.—The citizens have voted in favor of erecting a $40,000 high school.

Gillett, Wis.—It is reported that the issue of $18,000 bonds for the erection of a school has been authorized.

**Rice Lake, Wis.*—The Chippewa Falls Constr. Co., it is stated, has received the contract to erect the high school at $26,806, the Dwyer Plumbing & Heating Co., the contract for the heating at $5,290, and L. E. Post the contract for the plumbing at $1,584.

Milwaukee, Wis.—The Alumni Assoc. of the St. Francis Seminary, it is stated, is contemplating the erection of a library at a cost of about $50,000.

Munroe, Wis.—It is reported that the School Bd. has decided to erect schools at a cost of $40,000.

St. Croix Falls, Wis.—W. C. Reilly, Chmn. Bldg. Com., Osceola, Wis., writes that all bids opened July 14 for furnishing material and erecting a teachers' training school at St. Croix Falls, have been rejected, and new bids will be received July 24.

Toronto, Ont.—A $20,000 Sunday school building is to be erected for the St. Paul Church on Avenue Road.

STREET CLEANING AND GARBAGE DISPOSAL

Notes Arranged Alphabetically by States.

Chicago, Ill.—Bids for the collection and disposal of garbage will not be called for again until about the middle of September.

Indianapolis, Ind.—Bids will be received until Aug. 21 by the Dept. Pub. Wks. (M. A. Downing, Pres.) for the collection, removal, delivery and disposal of garbage and dead animals and the disposal of night soil for a period of 10 years, also on same date for the collection, removal and disposal of ashes and sweepings for a period of 10 years.

Grand Rapids, Mich.—Local press reports state that this city will in August take up the question of installing a garbage crematory.

**Atlantic City, N. J.*—E. P. Donnelly, City Clk., writes that the contract for collecting refuse from April to September (bids opened July 10) has been awarded to the Atlantic Product Co., of Atlantic City, for $43,300.

New York, N. Y.—Bids will be received until July 26 by J. McG. Woodbury, Comr. Street Cleaning, for furnishing material and removing the snow and ice in the Boro. of Bronx.

**Philadelphia, Pa.*—The following are reported to be the bids opened July 13 by A. Lincoln Acker, Dir. Dept. Pub. Wks., for the collection and disposal of garbage for the year 1906: Penn Reduction Co., $399,575 (awarded contract); American Product Co., $494,000, and Jas. Curran, $529,000.

A. E. Peterson, Thos. S. Laudenback and Lewis Moore are among the incorporators of the Penn Reduction Co., which secured the contract for disposing of the city's garbage next year as noted above. The company is reported to have engaged Geo. Beaston as its engineer, and he will have charge of the construction of the two plants the company proposes to establish.

NEW INDUSTRIAL PLANTS.

See also Business Buildings.

Jones Bros. Drug Co., Gulfport, Miss., is preparing plans for a 25 to 30-ton ice plant to be installed about January 1, 1906, together with engine and boiler plant.

The Endicott-Johnson Co., Endicott, N. Y., is erecting a 160x60-ft., 5-story addition to its shoe factory.

National Cast Steel Co., Avonmore, Pa., has purchased the plant of the Avonmore Construction Co., and is remodeling a portion of it.

Hugh McLean Lumber Co., Buffalo, N. Y., will shortly begin the erection at Memphis, Tenn., of a band saw mill, having a capcity of 25,000 to 30,000 ft. of quarter-cut oak per day. The plant will be equipped with steam derrick and other modern facilities for handling lumber.

New Evansville Foundry Association, Evansville, Ind., is erecting a new moulding shop, measuring 144x65 ft.

The Standard Stamping Co., Marysville, Ohio, will build an addition to its present plant, to measure about 75x30. A 25 or 30-hp. steam plant will be installed.

J. G. Ralston, Waterloo, Ia., is preparing plans for a canning factory to be located at Tripoli, Ia. The new plant will consist of main building, 33x80 ft., and office, boiler and fuel building, 22x60 ft.

Hays Mfg. Co., Erie, Pa., is building an addition to its plant, consisting of machine shop, 50x160 ft., and foundry building, 60x198 ft. This company will at the present time install new engine and boiler. Additional power equipment will be installed later on.

Independent Oil and Fertilizer Works, Columbus, Miss., is in the market for the following power equipment: Two engines, two high-pressure boilers, each with 3,000 sq. ft. heating surface; one feed water heater.

The Davis Sewing Machine Co., Dayton, O., has purchased property on which will be erected an addition to its present plant, according to local newspaper reports.

Fred T. Kellogg, Springfield, Mass., has had plans prepared for an addition to his present factory building, according to local newspaper reports.

D. L. Harper and Sol. Ryan, Galena, Kan., will erect a flour mill, measuring 50x50 ft., 3 stories high and having a capacity of 500 bbl. flour and 25,000 lbs. feed per day. About 60 hp. will be required.

Renfrew Mfg. Co., Adams, Mass., is erecting an addition to its plant consisting of dye-house, 186x68 ft.; drug room, 60x64 ft., and yarn building, 102x70 ft.

A correspondent writes that F. C. Meyer & Co., Augusta, Ga., will erect a grain elevator, to cost about $15,000.

A. Newman & Co., Philadelphia, Pa., shoe mfrs., will erect a 60x70-ft. factory building.

American Acid & Alkali Co., Bradford, Pa., announces that it is in the market for one second-hand, 110-120-kw., 200-220-volt, 2-phase, alternating-current generator, direct connected to steam or gas engine. Gas-driven unit is preferred.

The Champion Iron Co., Kenton, O., is adding to its power equipment, and is in the market for a 200-kw. generator direct connected to engine, together with boiler outfit.

J. B. Hicks Gas Motor Co., Waycross, Ga., is erecting a 50x100 ft. plant for the manufacture of gas engines and automobiles. This company is in the market for lathes, drilling and milling machines, screw machines, emery stands, etc.

Norcross-West Marble Co., Dorset, Vt., has recently purchased extensive marble properties and will shortly begin the erection of a plant.

Odlum Boiler Co., Memphis, Tenn., will erect a 50x400 ft. plant for the manufacture of boilers, tanks, riveted pipe and other plate and sheet work. This company is in the market for 150 tons structural steel work, direct-connected Corliss engine and generator; A. C. electric crane; a number of A. C. motors, and full boiler shop equipment, such as riveters, rolls, punches, shears, drills, etc.

American Can Co. will erect in New Orleans, La., a plant which will cost $300,000 and give employment to 300 persons, according to local newspaper reports.

Falls City Brewing Co., Louisville, Ky., has purchased property in Louisville upon which it will shortly begin the erection of a $250,000 brewery, according to local newspaper reports.

The R. A. Johnston Co., Milwaukee, Wis., is about to begin the erection of a $20,000 addition to its present plant, according to local newspaper reports.

The Peters Pork Packing Co., McKeesport, Pa., is preparing plans for a cold storage plant and cattle pens, according to local newspaper reports.

Glendale (Tex.) Lumber Co. will erect a saw mill plant having a capacity of 40,000 ft. per day and consisting of the following buildings: Saw mill proper, 40x120 ft.; planer, 48x75 ft.; power house, 32x48 ft.; 150 hp. will be required.

MISCELLANEOUS.

Notes Arranged Alphabetically by States.

Mobile, Ala.—The following are the bids opened on July 14 by Maj. W. E. Craighill, Corps Engrs., U. S. A., for dredging in Mobile Harbor; the material to be composed of sand gravel, oyster shells and soft clay (price given per cu. yd.): Geo. W. Catt, Park Row Bldg., New York, N. Y., 9.5 cts.; Geo. G. Barker, Wilmington, Del., 8.3 cts. (recommended for acceptance); Southern Dredging Co., Mobile, 8.4 cts.

Walnut Hill, Ark.—It is stated that bids will be received until Aug. 8 by the Long Prairie Levee Bd. (A. Stewart, Pres.) for constructing a levee from Bunkham Springs, Ark., to the Louisiana State Line, in all about 700,000 cu. yds.

Redlands, Cal.—It is reported that bids will be received until Aug. 2 for $100,000 municipal improvement bonds. L. W. Clark, City Clk.

**Items marked thus give the names of parties awarded contracts.*

Los Angeles, Cal.—Bids will be received until Aug. 10 by Capt. C. H. McKinstry, Corps Engrs., U. S. A., Los Angeles, for dredging in Wilmington Harbor, Cal.

San Francisco, Cal.—Bids will be received by the California Debris Comn., until Aug. 18, for building inlet wall at Daguerra Point Cut, Yuba River, Cal., as advertised in The Engineering Record.

Angel Island, Cal.—Press reports state that a detention station modeled after plans of the immigrant station on Ellis Island in N. Y. Harbor is to be constructed by the U. S. Government at Angel Island.

New London, Conn.—Bids will be received by Lieut. Col. C. F. Powell, Corps Engrs., U. S. A., New London, until Aug. 3, for dredging at Norwalk and Stamford Harbors, rock removal at Southport Harbor and dredging at Southport, Five Mile River and Greenwich Harbors, Conn., as advertised in The Engineering Record.

Cripple Creek, Colo.—Press reports state that final details for the commencement of driving the new drainage tunnel have been perfected, and work on construction will probably soon commence; it will be about 3½ miles in length and cost $750,000. A. C. Jacquith will be engineer in charge.

Washington, D. C.—Bids will be received until Aug. 12 by Mordecai T. Endicott, Ch. Bureau of Yards and Docks, Navy Dept., Washington, for steel work and fireproofing for fire and telephone station, Navy Yard, Washington.

Bids will be received at the office of the Comrs. D. C. on Aug. 21 for one 15-ton electric traveling crane for the sewerage pumping station, as advertised in The Engineering Record.

Bids will be received until July 31 by M. R. Thorp, Chief of Supply Division, War Dept., Washington, for furnishing steel file case in 2 vertical sections, each section containing not less than 28 drawers.

Key West, Fla.—Bids will be received until Aug. 26 by Mordecai T. Endicott, Ch. Bureau of Yards & Docks, Navy Dept., Washington, D. C., for filling and grading at the naval station, Key West, Fla.

Pensacola, Fla.—The following are the bids opened on July 15 by the Bureau of Yards and Docks, Navy Dept., Washington, D. C., for coal handling and coal installations for Bldg. No. 47, Navy Yard, Pensacola: (*a*) work complete; (*b*) with certain modifications: The Snare & Triest Co., New York, N. Y., *a* $23,888, *b* $29,500; Robins Conveying Belt Co., New York, N. Y., *b* $15,945, extras $2,094; Webster Mfg. Co., 38 Dey St., New York, N. Y., *a* $18,372, *b* 2 bids, $13,955 and $14,435; Link-Belt Engr. Co., Nicetown, Philadelphia, Pa., *b* $14,640; Heyl & Patterson, Inc., 51-53 Water St., Pittsburg, Pa., *a* $19,500, *b* $15,900.

Prophetstown, Ill.—Pollard, Goff & Co., of Champaign, are stated to have secured the contract for constructing a 12-mile drainage ditch to empty into Green River (bids opened June 29) at 6 cts. per cu. yd. Engineer, F. W. Sears, Prophetstown.

Chicago, Ill.—M. H. McGovern, 84 La Salle St., is stated to have secured the contract for constructing 8,218 lin. ft. 16-ft. brick tunnel in Lawrence Ave. (bids opened July 7), at $79.50 per lin. ft.

Vincennes, Ind.—The Comrs. of Knox County are reported to have awarded the contract for the construction of a levee along Wabash River to Edw. Craig & Co., for $10,325.

Indianapolis, Ind.—Plans will be received until Jan. 1, 1906, by the Bd. of Comrs. of the Oliver P. Morton Monument (D. R. Lucas, Secy., Rm. 25, State House, Indianapolis) for a pedestal and statue of Governor Morton.

Adel, Ia.—Bids will be received until Aug. 2 by the Bd. of Superv. for constructing certain county tile drain and open ditch in Dallas Township. Henry R. Lods, Co. Aud.

Panama.—Bids will be received at the office of D. W. Ross, General Purchasing Agent of the Panama Canal Comn., at Washington, D. C., on Aug. 17, for printing presses, door bolts, hinges, wire rope, etc.; also on Aug. 19 for 2 dipper dredges and on Aug. 22 for steam hammers, radial drills, etc., all three proposals advertised in The Engineering Record.

Bids will be received until Aug. 2 by the Isthmian Canal Comn. (D. W. Ross, Gen. Purchasing Officer, Washington, D. C.) for furnishing yellow pine, redwood and cypress lumber at Panama.

New Orleans, La.—Contracts for furnishing rock, bids opened July 5, by Capt. J. F. McIndoe, Corp. Engr., U. S. A., have been awarded as follows (price given per ton): To J. J. Ball & Co., Arkansas City, Ark., for 23,000 tons rock at Vidalia, La., $2.05; Bancroft, Ross, Sinclair Co., Ltd., New Orleans, for 7,000 tons in New Orleans Harbor, $2.20, and to Dominico Tranchina, New Orleans, for 2,500 tons in New Orleans Harbor, $1,72.

Portland, Me.—The following are the bids opened July 12 by Lieut. Col. W. M. Black, Corps Engrs., U. S. A., for dredging in Portland Harbor: (*a*) Fore River, 875,000 cu. yds., per cu. yd.: (*b*) Dry Dock, 87,500 cu. yds., per cu. yd.: (*c*) Back Cove, 450,000 cu. yds., per cu. yd.; (*d*) grand total: Coastwise Dredging Co., Norfolk, Va., *a* 13½ cts., *b* 14.8 cts., *c* 20.9 cts., *d* $205,125; Eastern Dredging Co., Boston, Mass., *a* and *b* 30 cts., *c* 60 cts., *d* $230,000; The International Contr. Co., New York, N. Y., *a* 13.5 cts., *b* 16.5 cts., *c* 25 cts., *d* $347,875; J. S. Packard Dredging Co., Providence, R. I., *a* 17 cts., *b* 30 cts., *c* 17 cts., *d* $251,500.

Baltimore, Md.—Surveyors of the offices of Harbor Engr. Hutton and City Engr. Fendall are reported to be making surveys of the lowland section bordering on Jones' Falls, with a view of ascertaining the practicability of raising that section from 6 to 10 ft. as a preventive of floods.

The Western Maryland R. R. Co. (H. G. Clark, Mgr., Baltimore) is reported to have prepared plans and specifications for a pier to be erected at Port Covington. It will be about 600 ft. long and 51 ft. wide.

Boston, Mass.—The following are the bids opened July 14 by Col. W. S. Stanton, Corps Engrs., U. S. A., for dredging in Chelsea Creek: price given per cu. yd.): Bay State Dredging Co., Boston, 29 cts.; Daly & Hannan Dredging Co., Ogdensburg, N. Y., 30.5 cts., and Eastern Dredging Co., Boston, 31.5 cts.

The following are reported to be the bids opened July 12 by the Supt. of Streets for construction of subway under tracks of the Fitchburg division of the B. & M. R. R., at Raymond St., (*a*) granite, (*b*) granolithic: Wm. Crane, *a* $6,477, *b* $6,677; T. H. Gill & Co., *a* $8,180, *b* $7,640; Falley & Kelley, *a* $5,900, *b* $5,600. J. B. Byrne, *a* $6,887, *b* $8,737; Simpson Bros., *a* $6,566, *b* $6,266 and H. A. Hanscom, *a* $6,100, *b* $5,900.

Greenville, Miss.—The following are the bids opened July 10 by the Bd. of Mississippi Levee Comrs. (C. H. West, Ch. Engr.) for levee work: *a* 140,000 cu. yds., per cu. yd.; *b* 510,000 cu. yds., per cu. yd.; *c* 250,000 cu. yds., per cu. yd.; *d* grand total: Roach, Stansell & Co., Scimitar Bldg., Memphis, Tenn., *a* 27.9 cts., *b* 18.45 cts., *c* 17.4 cts., *d* $176,655 (awarded contract); John Scott & Son, St. Louis, Mo., *a* 29.7 cts., *b* 22 cts., *c* 19 cts., *d* $201,280; John G. Sessions, Greenville, Miss., *a* 18.6 cts., and McCadden Constr. Co., Little Rock, Ark., *c* 20.45 cts. Robt. Somerville, Asst. Ch. Engr.

Elsberry, Mo.—Bids will be received until Aug. 3 by the Comrs. of Kings Lake (Mo.) Levee Dist. (J. J. Shaw, Secy.), Elsberry, for about 100,000 cu. yds. of earth work.

Glendive, Mont.—Specifications are on file at the office of The Engineering Record, 114 Liberty St., New York, N. Y., for furnishing from 12,000 to 16,000 bbls. Portland cement, f. o. b. Glendive, bids to be opened July 31; also for furnishing 600,000 lbs. square steel bars for reenforcement of concrete, to be opened Aug. 21, both to be received at the office of the Engineer, U. S. Reclamation Service, Glendive, as advertised in The Engineering Record.

New York, N. Y.—Bids will be received until July 28 by Maurice Featherson, Comr. of Docks, Dept. of Docks & Ferries, for furnishing and delivering granite stone for bulkhead or river wall.

Buffalo, N. Y.—The lowest bid opened on July 12 by Francis G. Ward, Comr. of Pub. Wks., for rebuilding nose of inlet pier in Niagara River at Massachusetts Ave., was submitted by the Buffalo Dredging Co., Morgan Bldg., for $34,940.

Cleveland, O.—The following are the bids recently received by the Bd. of Pub. Service for grading in Brookside Park: Kirby & Brown, $24,948; Williams Bros. & Morse, $22,896; Northern Ohio Paving & Constr. Co., The Arcade, $22,624, and J. W. Norton, $23,915.

Columbus, O.—Bids will be received until July 31 by the Bd. Pub. Service (Chas. H. Frank, Secy.), for furnishing and erecting approximately 3,400 signs on buildings and 1,300 on posts.

Cleveland, O.—Bids will be received until Aug. 8 by the Co. Comrs. for improving Dover Ditches. The improvement includes approximately 33,260 cu. yds. excavation, and is estimated to cost about $4,989. Wm. H. Evers, Co. Surveyor.

Philadelphia, Pa.—The New Jersey Fdy. & Machine Co., New York, N. Y., bid $14,700 for metal work for foundation of elbow of Cross Ledge Light Station, Delaware Bay, N. J.; bids for this work opened July 7 by Maj. J. C. Sanford, Corps Engrs., U. S. A.

The Batcheller Pneumatic Tube Co. is about to lay 6 miles of 8-in. pneumatic tubes for postal purposes in Philadelphia. Specifications of the street work, trenching, laying and paving, can be seen at the office of the company, 1038 Ridge Ave.

Pittsburg, Pa.—The Common Council has passed the ordinance and Mayor Hays has signed the same, providing for the hump removal. An election to vote on issuing bonds for this work will be held Aug. 22.

Braddock, Pa.—Plans are reported to have been completed for the construction of a $25,000 wharf at the foot of either 8th or 2d St.

Newport, R. I.—Bids will be received by Lieut. Col. J. H. Willard, Corps Engrs., U. S. A., until Aug. 18, for dredging in Woods Hole Channel, Mass., as advertised in The Engineering Record.

Galveston, Tex.—The contract for jetty work at Galveston, mouth of Brazos River and Aransas Pass, Tex. (bids opened June 28 by Capt. Edgar Jadwin, Corps Engrs., U. S. A.) has been awarded to Chas. Clark & Co., of Galveston, for all three harbors, for a total of $427,930. They bid on all the harbors for 27,000 tons small rip rap, $3.12 per ton; 89,000 tons large rip rap, $3.73 per ton, and for 3,500 tons large blocks, $4.48 per ton.

Norfolk, Va.—Bids will be received Aug. 11 by E. Eveleth Winslow, Corps Engrs., U. S. A., Norfolk, for dredging Pagan River, Va., as advertised in The Engineering Record.

Pittsburg, Pa.—The following are the bids opened June 26 by Maj. Wm. L. Sibert, Corps Engrs., U. S. A., for removing old bear-trap gate, remodeling foundation and piers, and erecting new bear-trap gate at Davis Island Dam, Ohio River: (*a*) The Dravo Contr. Co.; (*b*) Baker Contract Co.

	a	*b*
500 cu. yds. excav	$1.50	$1.00
400 cu. yds. concrete	10.00	8.00
39 M. ft. oak timber	100.00	100.00
31 M. ft. Allegheny River pine	85.00	100.00
12,000 lbs. bolts, washers, driftbolts, etc	.05	.06
40,000 lbs. medium steel	.10	.07
22,000 lbs. cast steel	.12	.08
12,000 lbs. cast iron	.05	.06
40 cu. yds. concrete and stone to be cut out	10.00	20.00
Old gate, valves, irons and timber to be removed (lump sum)	3,000.00	2,000.00
Total	$22,525	$19,500

Galveston, Tex.—Local press reports state that land for lock No. 1 in the Trinity River has been deeded to the U. S. Government and plans and specifications for this improvement, which will cost about $163,000, have been forwarded to Washington, D. C., for approval. When returned bids will be called for. It is proposed to construct 3 locks in Trinity River under present appropriation of $400,000. Capt. Edgar Jadwin, Corps Engrs., U. S. A., Galveston, is in charge of this district.

La Crosse, Wis.—The City Council is reported to be considering the question of constructing a new causeway over the marsh connecting the north and south sides. Probable cost, $20,000.

Ottawa, Ont.—The Ottawa House of Commons is reported to have passed a bill providing for the construction of a canal along Holland River, from Lake Simcoe to Aurora; probable cost of work, $328,000.

PROPOSALS OPEN

For Proposals see pages 56, 58, 60 61, 62 63 AND 64

WATER WORKS.

Bids Close.		See Eng. Record.
Jul. 18.	System, Wahpeton, N. D	Jun. 17
Jul. 18.	Mains and reservoir, Havre, Mont Adv. Jun. 24, Jul. 1.	Jun. 24
Jul. 18.	Hydrants, etc., Washington, D. C	Jul. 1
Jul. 19.	Pumps and engines, Panama Adv. Jun. 24 to Jul. 15.	Jun. 24
Jul. 19.	Pumps, Brooklyn, N. Y	Jul. 1
Jul. 19.	Reservoir, Rochester, N. Y Adv. Jul. 8, 15.	Jul. 8
Jul. 19.	Mains, New York, N. Y	Jul. 8
Jul. 19.	Pipe, etc., Long Island City, N. Y	Jul. 8
Jul. 19.	Pump station, etc., Brooklyn, N. Y	Jul. 15
Jul. 19.	Extending system, Lancaster, O	Jul. 15
Jul. 20.	Ft. Pierre, S. D.	Jul. 1
Jul. 20.	Tunnel, Chicago, Ill	Jul. 8
Jul. 22.	Water works, Turin, N. Y	Jul. 15
Jul. 22.	Water wks., Winside, Neb.	Jul. 15
Jul. 25.	Pipe, Cleveland Hgts., O	Jul. 1
Jul. 25.	Hydrants, etc., Washington, D. C	Jul. 15
Jul. 25.	Improv., Boonville, Mo	Jul. 22
Jul. 25.	Water wks. improv., Laurens, S. C	Jul. 22
Jul. 27.	Pipe, etc., Lorain, O.	Jul. 22
Jul. 27.	Improv., Garnett, Kan.	Jul. 22
Jul. 28.	Valves, Cincinnati, O.	Jul. 8
Jul. 28.	Well, Chicago, Ill.	Jul. 15
Jul. 29.	Pumps, Brooklyn, N. Y	Jun. 24
Jul. 29.	Tunnel, Chicago, Ill	Jul. 15
Jul. 31.	Pump, etc., Elyria, O Adv. Jul. 15, 22.	Jul. 15
Jul. 31.	Brass goods, Winnipeg, Man Adv. Jul. 22.	Jul. 22
Jul. —.	Water wks., Morehead City, N. C	Jun. 17
Aug. 1.	Charleston, N. H.	Jul. 8
Aug. 1.	Laying pipe, etc., Cincinnati, O Adv. Jul. 8 to 22.	Jul. 8
Aug. 1.	Distribution system, Ashland, Pa Adv. Jul. 22.	Jul. 22
Aug. 1.	Reservoir dam, Longmont, Colo. Adv. Jul. 22.	Jul. 22
Aug. 3.	Mains, Madison, S. D	Jul. 22
Aug. 3.	Water wks., Mascoutah, Ill	Jul. 22
Aug. 5.	Mains, Norwood, O.	Jul. 15
Aug. 5.	Water wks., Barnesville, Minn	Jul. 22
Aug. 7.	Pumping plant, Winnipeg, Man Adv. Jul. 8 to 22.	Jul. 8
Aug. 7.	Filter plant, St. Cloud, Minn	Jul. 15
Aug. 7.	Pipe, Homestead, Pa	Jul. 15
Aug. 8.	Water works, Columbia, S. C. Adv. Jul. 1, 8, 22.	Jul. 1
Aug. 8.	Pipe, etc., Cincinnati, O	Jul. 22
Aug. 8.	Water wks., Hammond, La	Jul. 22
Aug. 8.	Dam, pipe line, etc., Oneida, N. Y Adv. Jul. 22.	Jul. 22
Aug. 9.	Improv., Ft. Revere, Hull, Mass	Jul. 22
Aug. 11.	Stand pipe and tank, Grand Rapids, Mich. Adv. Jul. 22.	Jul. 22
Aug. 12.	Water wks., Newark, O Adv. Jul. 15, 22.	Jul. 15
Aug. 14.	Pipe, etc., Lyndhurst, N. J Adv. Jul. 22.	Jul. 22
Aug. 15.	Reservoir, etc., Ft. McPherson, Ga Adv. Jul. 22.	Jul. 22
Aug. 16.	Dam, etc., Casper, Wyo. Adv. Jul. 22.	Jul. 22
Aug. 17.	Irrigation, Yuma, Ariz. Adv. Jun. 17 to Jul. 22.	Jun. 17
Aug. 28.	Canal, etc., Montrose, Colo. Adv. Jul. 15, 22	Jul. 15
Aug. 30.	Improv., Owensboro, Ky.	Jul. 15
Aug. —.	Water wks., Bolivar, Tenn	Jul. 15
Aug. —.	Improv., Donalsonville, La.	Jul. 15
Sept. 5.	Dam, etc., Cody, Wyo Adv. Jul. 15, 22.	Jul. 15
Sept. 6.	Tunnel, etc., Cody, Wyo. Adv. Jul. 15 to 22	Jul. 15
———	Water wks., Utica, Miss.	Jul. 15

SEWERAGE AND SEWAGE DISPOSAL.

Bids Close.		See Eng. Record.
Jul. 18.	Wahpeton, N. D.	Jun. 17
Jul. 18.	Lebanon, O. Adv. Jul. 8, 15.	Jul. 8
Jul. 18.	Oconto, Wis.	Jul. 15
Jul. 18.	Summit, N. J. Adv. Jul. 15	Jul. 15
Jul. 18.	Perry, Ia	Jul. 15
Jul. 19.	Brooklyn, N. Y	Jul. 8
Jul. 19.	Beloit, Wis.	Jul. 8
Jul. 19.	Indianapolis, Ind.	Jul. 15
Jul. 20.	St. Paul, Minn	Jul. 15
Jul. 21.	Utica, N. Y. Adv. Jun. 17 to Jul. 15.	Jun. 17
Jul. 21.	Mauston, Wis.	Jul. 15
Jul. 22.	Ogden, Utah	Jul. 1
Jul. 22.	Lexington, Ky	Jul. 15
Jul. 24.	Washington, D. C. Adv. Jul. 8, 15.	Jul. 8
Jul. 24.	Portsmouth O.	Jul. 15
Jul. 24.	Marietta, O.	Jul. 15
Jul. 24.	Cincinnati, O.	Jul. 15
Jul. 25.	Laurens, S. C. Adv. Jul. 1, 8.	Jul. 1
Jul. 25.	Tampa, Fla. Adv. Jul. 8 to 22.	Jul. 8
Jul. 25.	Columbus, O.	Jul. 15
Jul. 25.	Huntington, Ind.	Jul. 15
Jul. 25.	Merril, Wis.	Jul. 22
Jul. 25.	Wellston, O.	Jul. 22

Items marked thus give the names of parties awarded contracts.

Jul. 27.	Cincinnati, O.	Jul. 15
Jul. 27.	Mansfield, O.	Jul. 15
Jul. 27.	Scotia, N. Y.	Jul. 22
Jul. 27.	Dayton, O. Adv. Jul. 22.	Jul. 22
Jul. 29.	Lewisburg, Pa.	Jul. 22
Aug. 1.	Toronto, Ont.	Jun. 17
Aug. 1.	Washington, D. C. Adv. Jul. 8 to 22.	Jul. 8
Aug. 1.	Charleston, N. H.	Jul. 8
Aug. 1.	Anaconda, Mont.	Jul. 8
Aug. 1.	Lake Placid, N. Y	Jul. 15
Aug. 1.	Windom, Minn.	Jul. 22
Aug. 2.	Pipestone, Minn.	Jul. 15
Aug. 2.	Wyandotte, Mich.	Jul. 22
Aug. 3.	Massillon, O.	Jul. 22
Aug. 5.	Alliance, O.	Jun. 24
Aug. 5.	West Haverstraw, N. Y Adv. Jul. 22.	Jul. 22
Aug. 8.	West Point, N. Y. Adv. Jul. 15, 22.	Jul. 15
Aug. 11.	Cincinnati, O.	Jul. 15
Aug. 11.	Grand Rapids, Mich. Adv. Jul. 22.	Jul. 22
Aug. 12.	Norwood, O.	Jul. 22
Aug. 14.	Cincinnati, O.	Jul. 22

BRIDGES.

Jul. 18.	Anderson, Ind.	Jul. 1
Jul. 18.	Marietta, O.	Jul. 1
Jul. 19.	Superstructure, Hartford, Conn. Adv. Jul. 8.	Jul. 8
Jul. 19.	Substructure, Hartford, Conn. Adv. Jul. 8.	Jul. 8
Jul. 20.	Oglethorpe, Ga.	Jul. 8
Jul. 20.	Charleston, W. Va. Adv. Jul. 8.	Jul. 8
Jul. 20.	Litchfield, Minn.	Jul. 8
Jul. 20.	Buffalo, N. Y.	Jul. 15
Jul. 24.	Bloomington, Neb.	Jul. 15
Jul. 24.	Hackensack, N. J.	Jul. 22
Jul. 25.	Graham, Tex.	Jul. 22
Jul. 25.	Somerville, N. J.	Jul. 22
Jul. 26.	Perth Amboy, N. J Adv. Jul. 15.	Jul. 15
Jul. 26.	Montvale, N. J.	Jul. 22
Jul. 26.	West Chester, Pa.	Jul. 22
Jul. 26.	Hackensack, N. J	Jul. 22
Jul. 27.	Dayton, O.	Jul. 15
Jul. 27.	Mansfield, O.	Jul. 15
Jul. 27.	Boston, Mass.	Jul. 22
Jul. 28.	Whitehall, Mich.	Jul. 15
Jul. 28.	Kittanning, Pa.	Jul. 22
Jul. 29.	Cleveland, O.	Jul. 15
Jul. 29.	Denver, Col.	Jul. 15
Jul. 31.	Danville, Ind.	Jul. 15
Aug. 1.	Elmira, N. Y. Adv. Jul. 15, 22.	Jul. 15
Aug. 3.	Springfield, O.	Jul. 22
Aug. 7.	Mt. Clemens, Mich.	Jul. 22
Aug. 7.	Marion, O.	Jul. 22
Aug. 7.	Frankfort, Ind.	Jul. 22
Aug. 7.	Clarksdale, Miss.	Jul. 22
Aug. 8.	Merced, Cal.	Jul. 22
Aug. 8.	Fargo, N. D.	Jul. 22
Aug. 10.	Bridgeport, Conn. Adv. Jul. 22.	Jul. 27
Aug. 10.	New York, N. Y.	Jul. 22
Sept. 8.	Virginia City, Mont.	Jul. 22

PAVING AND ROADMAKING.

Jul. 18.	East St. Louis, Ill.	Jul. 8
Jul. 18.	Oneonta, N. Y. Adv. Jul. 8, 15.	Jul. 8
Jul. 18.	McKees Rocks, Pa.	Jul. 8
Jul. 18.	Allentown, Pa. Adv. Jul. 15	Jul. 15
Jul. 18.	Ingram, Pa.	Jul. 15
Jul. 18.	Waterbury, Conn.	Jul. 15
Jul. 18.	Morris, Conn.	Jul. 15
Jul. 18.	Butler, Pa	Jul. 15
Jul. 19.	Hartford, Conn. Adv. Jul. 8.	Jul. 8
Jul. 19.	Brooklyn, N. Y.	Jul. 8
Jul. 19.	Freeport, Ill. Adv. Jul. 15	Jul. 15
Jul. 20.	Washington, D. C. Adv. Jun. 24 to Jul. 15.	Jun. 24
Jul. 20.	Port Clinton, O.	Jul. 8
Jul. 20.	Columbus, Ind.	Jul. 15
Jul. 21.	Creston, Ia.	Jul. 8
Jul. 21.	Buffalo, N. Y.	Jul. 15
Jul. 22.	Des Moines, Ia.	Jul. 8
Jul. 22.	Des Moines, Ia.	Jul. 15
Jul. 22.	Indiana, Pa.	Jul. 15
Jul. 22.	Dorranceton, Pa.	Jul. 15
Jul. 22.	Orvil, N. J.	Jul. 15
Jul. 24.	Flemington, N. J. Adv. Jul. 1 to 15.	Jul. 1
Jul. 24.	Indianapolis, Ind.	Jul. 15
Jul. 24.	Southampton, Pa.	Jul. 15
Jul. 25.	Wilmington, N. C.	Jul. 8
Jul. 25.	Tampa, Fla. Adv. Jul. 8 to 22.	Jul. 8
Jul. 25.	Centreville, Md.	Jul. 15
Jul. 25.	Columbus, O.	Jul. 15
Jul. 25.	Cumberland, Md.	Jul. 15
Jul. 25.	Lincoln, Ill.	Jul. 22
Jul. 25.	Delphi, Ind.	Jul. 22
Jul. 25.	West Homestead, Pa.	Jul. 22
Jul. 26.	Cincinnati, O.	Jul. 8
Jul. 26.	Hoboken, N. J.	Jul. 15
Jul. 26.	Chicago, Ill.	Jul. 22
Jul. 26.	Findley, O.	Jul. 22
Jul. 27.	Xenia, O. Adv. Jun. 24 to Jul. 15.	Jun. 24
Jul. 27.	Ft. De Soto, Fla.	Jul. 8
Jul. 27.	Rhinelander, Wis.	Jul. 1
Jul. 27.	Cincinnati, O.	Jul. 8
Jul. 27.	Mansfield, O.	Jul. 15
Jul. 28.	Akron, O.	Jul. 15
Jul. 29.	New Orleans, La.	Jul. 8
Jul. 29.	Des Moines, Ia.	Jul. 15
Jul. 29.	Jersey Shore, Pa. Adv. Jul. 22.	Jul. 22
Jul. 31.	Monticello, Ind.	Jul. 15
Jul. 31.	Danville, Ind.	Jul. 15
Jul. 31.	Cincinnati, O.	Jul. 22
Jul. 31.	Tipton, Ind.	Jul. 22
Jul. 31.	Kinston, N. C.	Jul. 22
Aug. 1.	Belvidere, Ill.	May 20
Aug. 1.	Elizabeth, N. J.	Jul. 15
Aug. 1.	Denver, Colo.	Jul. 22
Aug. 1.	Bayonne, N. J. Adv. Jul. 22.	Jul. 22
Aug. 1.	Valley Forge, Pa.	Jul. 22
Aug. 1.	Buffalo, N. Y.	Jul. 22
Aug. 3.	Springfield, Mass.	Jul. 15
Aug. 4.	Washington, D. C., Adv. Jul. 15, 22.	Jul. 15
Aug. 5.	Panama	Jul. 8
Aug. 5.	Bricks, Panama	Jul. 15
Aug. 7.	Martinsville, Ind.	Jul. 15
Aug. 7.	Greensburg, Pa.	Jul. 15
Aug. 7.	Greensburg, Ind.	Jul. 22
Aug. 7.	Green Bay, Wis.	Jul. 22
Aug. 8.	Shreveport, La.	Jul. 1
Aug. 8.	Corydon, Ind.	Jul. 22
Aug. 8.	Knox, Ind.	Jul. 22
Aug. 8.	Vincennes, Ind.	Jul. 22
Aug. 8.	Logansport, Ind.	Jul. 22
Aug. 8.	Auburn, N. Y.	Jul. 22
Aug. 11.	Cincinnati, O.	Jul. 15
Aug. 14.	Cincinnati, O.	Jul. 22
Aug. 15.	Crownpoint, Ind.	Jul. 22
Aug. 21.	Johnston, N. Y.	Jul. 22
———	Osceola, Ia. Adv. Jun. 24, Jul. 1,	Jun. 24

POWER, GAS AND ELECTRICITY.

Jul. 18.	Washington, D. C.	Jun. 24
Jul. 18.	Washington, D. C.	Jul. 1
Jul. 20.	Fayetteville, N. C.	Jul. 8
Jul. 21.	Kansas City, Mo.	Jul. 8
Jul. 21.	El. light fixtures, Scranton, Pa.	Jul. 15
Jul. 21.	Chicago, Ill.	Jul. 15
Jul. 24.	New York, N. Y.	Jul. 15
Jul. 25.	Washington, D. C.	Jul. 15
Jul. 25.	Greenwood, Wis.	Jul. 15
Jul. 26.	El. light fixtures, Ft. Stevens, Ore.	Jul. 15
Jul. 31.	Monroe, Ga.	Jul. 15
Jul. 31.	Farmington, Mo.	Jul. 22
Jul. —.	Morehead City, N. C.	Jun. 17
Aug. 1.	Durant, Miss.	Jul. 15
Aug. 2.	Indianapolis, Ind.	Jul. 8
Aug. 4.	Jacksonville, Fla.	Jul. 22
Aug. 7.	Girardville, Pa.	Jul. 22
Aug. 10.	Bellefontaine, O.	Jul. 15
Aug. 10.	El. light fixtures, Washington, D. C.,	Jul. 22
Aug. 15.	Campbellsville, Ky.	Jun. 24
Aug. 24.	Fort Wayne, Ind.	Jul. 8
Aug. —.	Bolivar, Tenn.	Jul. 15
Oct. 1.	Tacoma, Wash.	Jul. 8

BUILDINGS.

Jul. 18.	Schools, Wahpeton, N. D.	Jun. 17
Jul. 18.	Schools, Youngstown, O.	Jul. 1
Jul. 18.	Engine house, Chicago, Ill.	Jul. 15
Jul. 18.	Hospital, New York, N. Y.	Jul. 15
Jul. 19.	Schools, Lancaster, O.	Jul. 1
Jul. 19.	Htg. school, Jeannette, Pa.	Jul. 15
Jul. 20.	Custom House, San Francisco, Cal.	Jun. 3
Jul. 20.	Court house, Mangum, Okla. Ter.,	Jul. 1
Jul. 20.	Courthouse, Manhattan, Kan.	Jul. 1
Jul. 20.	School, Montpelier, O.	Jul. 8
Jul. 20.	Hotel, Hinton, W. Va.	Jul. 15
Jul. 20.	School, Geneva, Ala.	Jul. 15
Jul. 20.	Post bldgs., Wash., D. C.	Jul. 15
Jul. 20.	Pub. bldg., Livingston, Tex.	Jul. 15
Jul. 20.	Bus. bldg., Livingstone, Tex.	Jul. 15
Jul. 21.	School plans, Concord, N. H.	Jul. 8
Jul. 21.	Schools, Monclova, O.	Jul. 15
Jul. 21.	Pub. bldgs., Ft. Revere, Mass.	Jul. 15
Jul. 21.	Schools, Chicago, Ill.	Jul. 15
Jul. 21.	Engine house, Portland, N. D.	Jul. 15
Jul. 22.	Hospital, New Orleans, La.	Jun. 17
Jul. 22.	Asylum bldg., Wernersville, Pa.	Jul. 15
Jul. 24.	P. O. Bldg., Fargo, N. D.	Jun. 17
Jul. 24.	School, Morning Sun, Ia.	Jul. 1
Jul. 24.	Court House, Washburn, N. D.	Jul. 8
Jul. 24.	Post bldgs., Ft. Mackenzie, Wyo. Adv. Jul. 8 to 22.	Jul. 8
Jul. 24.	School, Cincinnati, O.	Jul. 15
Jul. 24.	Htg. school, Cincinnati, O.	Jul. 15
Jul. 24.	Plumb., etc., school, Batavia, N. Y.	Jul. 15
Jul. 24.	School, New York, N. Y.	Jul. 15
Jul. 25.	P. O. Bldg., Muncie, Ind. Adv. Jun. 24 to Jul. 8.	Jun. 24
Jul. 25.	Fire station, Atlanta, Ga.	Jul. 15
Jul. 25.	Bus. bldg., Houston, Tex.	Jul. 15
Jul. 25.	Engine house, New York, N. Y.	Jul. 15
Jul. 25.	Plumb. school, Sharpsburg, Pa.	Jul. 22
Jul. 25.	Schools, Detroit, Mich.	Jul. 22
Jul. 26.	P. O. Bldg., Spartansburg, S. C. Adv. Jun. 24, Jul. 1.	Jun. 24
Jul. 26.	Fire hdqrs., Rochester, N. Y.	Jul. 15
Jul. 26.	I. O. O. F. bldg., Springfield, Mass.	Jul. 15
Jul. 26.	Engine house, Newark, N. J.	Jul. 15
Jul. 26.	Hospital, Lexington, Ky.	Jul. 15
Jul. 26.	Hospital, Ft. Michie, N. Y.	Jul. 22
Jul. 27.	Schools, Ft. Totten, N. D.	Jul. 1
Jul. 27.	Htg., etc., Post Office, Kansas City, Mo.	Jul. 8
Jul. 27.	Hospital addition, Ft. Casey, Wash.	Jul. 15
Jul. 27.	School, Columbus, O.	Jul. 15
Jul. 27.	Bus. bldgs., Baltimore, Md.	Jul. 22
Jul. 28.	Htg. custom house, St. Louis, Mo.	Jul. 22
Jul. 28.	Vent. pub. bldg., New York, N. Y.	Jul. 22
Jul. 29.	Barracks, etc., West Point, N. Y. Adv. Jul. 1 to 22.	Jul. 1
Jul. 29.	Library, Cleveland, O.	Jul. 8
Jul. 29.	Stone work for Pub. Bldg., Wash., D. C. Adv. Jul. 15, 22.	Jul. 15
Jul. 29.	Jail, Newport, Ark. Adv. Jul. 15, 22.	Jul. 15
Jul. 29.	School, Washington, D. C.	Jul. 22
Jul. 29.	Opera house, Glenwood, Minn.	Jul. 22
Jul. 30.	Court House improv., Leesville, La. Adv. Jul. 8.	May 13
Jul. 31.	Lighthouse bldgs., Detroit, Mich. Adv. Jul. 1 to 15.	Jul. 1
Jul. 31.	Vent. and htg. schools, Cleveland, O.	Jul. 8
Jul. 31.	Supreme Court Bldg., Jefferson City, Mo. Adv. Jul. 15, 22.	Jul. 15
Jul. 31.	School annex, Cleveland, O.	Jul. 15
Jul. 31.	Armory improv., New York, N. Y.	Jul. 22
Jul. 31.	School improv., New York, N. Y.	Jul. 22
Jul. 31.	Pub. bldg., Farmington, Mo.	Jul. 22
Aug. 1.	Power house, Wash., D. C.	Jul. 15
Aug. 1.	Y. M. C. A. Bldg., Spokane, Wash.	Apr. 29
Aug. 1.	Library, Louisville, Ky.	Jul. 1
Aug. 1.	School, Port Arthur, Tex.	Jul. 8
Aug. 1.	Lighthouse bldgs., Mobile, Ala.	Jul. 8
Aug. 1.	School, Washington, D. C.	Jul. 8
Aug. 1.	Capitol, Frankfort, Ky. Adv. Jul. 15.	Jul. 15
Aug. 1.	Hospital, Higginsville, Mo.	Jul. 15
Aug. 3.	Post bldgs., Cascade Locks, Ore.	Jul. 15
Aug. 3.	Pub. bldgs., Brooklyn, N. Y.	Jul. 22
Aug. 4.	School, Girard, O.	Jul. 22
Aug. 5.	Pub. bldg., Bremerton, Wash.	Jul. 1
Aug. 5.	Pub. bldg., Hot Springs, S. D.	Jul. 15
Aug. 5.	Infirmary, Carthage, O.	Jul. 15
Aug. 7.	P. O. Bldg., Adrian, Mich. Adv. Jul. 1, 8.	Jul. 1
Aug. 7.	Infirmary, Latonia, Ky.	Jul. 15
Aug. 7.	Post-Office improv., Calgary, Alta.	Jul. 15
Aug. 7.	Hospital, Rome, N. Y. Adv. Jul. 15, 22.	Jul. 15
Aug. 7.	Pub. bldg. supplies, Panama	Jul. 15
Aug. 7.	School, Athens, Ga.	Jul. 15
Aug. 7.	Hospital, Ft. Wood, N. Y. Adv. Jul. 22.	Jul. 22
Aug. 8.	Htg. jail, Aberdeen, Miss.	Jul. 22
Aug. 8.	School, Minot, N. D.	Jul. 22
Aug. 9.	Pub. bldgs., Chicago, Ill.	Jun. 17
Aug. 9.	School library, Bloomington, Ind. Adv. Jul. 8.	Jul. 8
Aug. 9.	Library, Louisville, Ky.	Jul. 22
Aug. 10.	Jail, Salem, Va.	Jul. 15
Aug. 11.	Htg. library, Cincinnati, O.	Jul. 22
Aug. 12.	School, Rocky River, O.	Jul. 22
Aug. 14.	Court House, Cedartown, Ga.	Jul. 8
Aug. 14.	U. S. Custom House, Baltimore, Md. Adv. Jul. 15, 22.	Jul. 15
Aug. 14.	School, Cleveland, O.	Jul. 22
Aug. 14.	Pub. bldg. improv., Cincinnati, O.	Jul. 22
Aug. 16.	P. O., McKeesport, Pa.	Jul. 15
Aug. 16.	Post bldgs., Ft. Mott, N. J. Adv. Jul. 22.	Jul. 22
Aug. 17.	Lighthouse, Buffalo, N. Y.	Jul. 15
Aug. 17.	P. O. extension, Burlington, Ia.	Jul. 15
Aug. 21.	Hospital, Southport, N. C.	Jul. 22
Aug. 26.	Htg. hotel, Cincinnati, O.	Jul. 22

MISCELLANEOUS.

Jul. 18.	Supplies, Washington, D. C.	Jun. 24
Jul. 18.	Supplies, Washington, D. C.	Jul. 1
Jul. 18.	Ties, etc., Washington, D. C.	Jul. 15
Jul. 20.	Dredging, Honolulu, H. I. Adv. Jun. 24 to Jul. 15.	Jun. 24
Jul. 20.	Rem. of wreck, Charleston, S. C. Adv. Jun. 24 to Jul. 15.	Jun. 24
Jul. 20.	Dredging, Norfolk, Va. Adv. Jul. 1, 15.	Jul. 1
Jul. 20.	Park wk. walls, etc., New York, N. Y.,	Jul. 15
Jul. 20.	Park work, trap rock, etc., New York, N. Y.	Jul. 15
Jul. 21.	Mchy. for lock, Pittsburg, Pa.	Jun. 24
Jul. 21.	Sweeping machines, New York, N. Y.,	Jul. 15
Jul. 21.	Sea wall, etc., New York, N. Y.	Jul. 15
Jul. 22.	Dredging, Boston, Mass.	Jul. 1
Jul. 24.	Destructor, Panama Adv. Jun. 24 to Jul. 22.	Jun. 24
Jul. 24.	Canal work, Portland, Ore.	Jul. 1
Jul. 24.	El. Rys., Panama	Jul. 8
Jul. 25.	Dredging, Chicago, Ill. Adv. Jul. 1 to 22.	Jul. 1
Jul. 25.	Supplies, Washington, D. C.	Jul. 15
Jul. 25.	Mchy. in laundry, New York, N. Y.	Jul. 15
Jul. 25.	Garb. disposal, Marion, Ind. Adv. Jul. 15, 22.	Jul. 15
Jul. 25.	R. R. wk., St. John, N. B.	Jul. 15
Jul. 26.	Garb. disposal, Hoboken, N. J.	Jul. 15
Jul. 26.	Removal of ice, etc., N. Y., N. Y.,	Jul. 22
Jul. 27.	Steel barges, Panama Adv. Jul. 1 to 22.	Jul. 1
Jul. 27.	Channel, etc., Boston, Mass.	Jul. 15
Jul. 28.	Bulkhead stone, New York, N. Y.	Jul. 22
Jul. 29.	Dredging, etc., Bremerton, Wash.	Jun. 24
Jul. 29.	Supplies, Panama	Jul. 1
Jul. 29.	Filling, etc., New Orleans, La.	Jul. 15
Jul. 31.	R. R. work, Miami, Fla. Adv. Jun. 24 to Jul. 22.	Jun. 24
Jul. 31.	Air compressors, etc., Panama Adv. Jul. 1 to 15.	Jul. 1
Jul. 31.	Cement, Glendive, Mont. Adv. Jul. 1 to 22.	Jul. 1
Jul. 31.	Lock gates, Pittsburg, Pa. Adv. Jul. 8 to 22.	Jul. 8
Jul. 31.	Supplies, Panama	Jul. 8
Jul. 31.	Steel case, Washington, D. C.	Jul. 22
Jul. 31.	Signs, Columbus, O.	Jul. 22
Aug. 1.	Supplies, Washington, D. C.	Jul. 8
Aug. 2.	Dredging, Savannah, Ga. Adv. Jul. 8 to 22.	Jul. 8
Aug. 2.	Retaining walls, etc., Cincinnati, O. Adv. Jul. 15, 22.	Jul. 15
Aug. 2.	Drains, Adel, Ia.	Jul. 22
Aug. 2.	Lumber, Panama	Jul. 22
Aug. 3.	Dredging, Seattle, Wash.	Jul. 15
Aug. 3.	Dredging, Cape Charles, Va. Adv. Jul. 8, 22.	Jul. 8
Aug. 3.	Dredging, New London, Conn. Adv. Jul. 22.	Jul. 22
Aug. 3.	Levee wks., Elsberry, Mo.	Jul. 22
Aug. 4.	Ditch, Rensselaer, Ind.	Jul. 15
Aug. 7.	Beacon superstructure, Buffalo, N. Y.,	Jul. 15
Aug. 8.	Dredge work, Wauseon, O.	Jul. 15
Aug. 8.	Ditch, Cleveland, O.	Jul. 22
Aug. 8.	Levee work, Walnut Hill, Ark.	Jul. 22
Aug. 9.	Dock, Chicago, Ill.	Jun. 17
Aug. 10.	Levee work, New Orleans, La. Adv. Jul. 15, 22.	Jul. 15
Aug. 10.	Dredging, Los Angeles, Cal. Adv. Jul. 22.	Jul. 22
Aug. 11.	Levee work, New Orleans, La. Adv. Jul. 15, 22.	Jul. 15
Aug. 11.	Supplies, Panama	Jul. 15
Aug. 11.	Dredging, Norfolk, Va.	Jul. 22
Aug. 12.	Steel work, etc., Washington, D. C.,	Jul. 22
Aug. 14.	Dredging, Detroit, Mich. Adv. Jul. 15, 22.	Jul. 15
Aug. 17.	Dredging, Norfolk, Va.	Jul. 15
Aug. 17.	Printing presses, etc., Panama Adv. Jul. 22.	Jul. 22
Aug. 18.	Dredging, Newport, R. I. Adv. Jul. 22.	Jul. 22
Aug. 18.	Inlet wall, San Francisco Adv. Jul. 22.	Jul. 22
Aug. 19.	Dredges, Panama Adv. Jul. 22.	Jul. 22
Aug. 21.	Steel bars, Glendive, Mont. Adv. Jul. 15, 22.	Jul. 15
Aug. 21.	Garb. disposal, Indianapolis, Ind.	Jul. 22
Aug. 21.	Crane for sewer, Washington, D. C. Adv. Jul. 22.	Jul. 22
Aug. 22.	Drills, etc., Panama Adv. Jul. 22.	Jul. 22
Aug. 26.	Coal plant, Olongapo, P. I.	May 6
Aug. 26.	Filling etc., Key West, Fla.	Jul. 22
Sep. 1.	Steel and iron, Sydney, N. S. Wales Adv. Apr. 8, 22; May 6, 20; Jun. 3, 17. Adv. Jul. 1, 15.	Apr. 8
Nov. 1.	R. R. work, Manila, P. I.	Jun. 17
Jan. 1.	Statue plans, Indianapolis, Ind.	Jul. 22
Apr. 2, '06.	Harbor Work, Valparaiso, Chili, Adv. Apr. 29 to Jul. 22.	Apr. 29
———	Dam, etc., Charlestown, W. Va. Adv. Jul. 8, 15.	Jul. 1